Ada, OS/2 and Aircraft Design

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Origin of Ada

- In the early 1970s the U.S. DoD concluded that it was spending too much money on maintaining software in too many different programming languages.
- High-order language working group (HOL WG) formed 1975 to establish requirements for common language.

Requirements

- Requirements refined in open review process: Strawman (April 1975), Woodenman (Aug 1975), Tinman (Jan 1976), Ironman (Jan 1977), Steelman (Jun 1978).
- No existing programming language could completely meet the requirements, but some came close enough to be suitable as a starting point (Algol 68, Pascal, PL/I).

Design competition

- In 1977 the U.S. DoD held a design competition on the basis of Ironman.
- Fifteen proposals received. The four best received a contract to further define their language.
- To preserve impartiality, the four submissions were only identified by a colour (green, blue, red, yellow)

And the winner is... green

- After worldwide review, the green proposal was selected in May 1979 (Cii-Honeywell Bull, lead by Jean Ichbiah).
- Named Ada in honour of Lady Augusta Ada Byron (1815-1842), considered to be the world's first ‘programmer’ (difference engine by Charles Babbage)

Ada 80, 83

- Mil Std 1815 (Dec 1980)
- Mil Std 1815A (Jan 1983), ANSI standard (Feb 1983), ISO standard 8652 (1987)
- Compilers were expensive.

Ada 95

- Ada 9X project started July 1988.
- Prime contractor Intermetrics, lead by S. Tucker Taft.
- Revised ANSI and ISO standards Feb 1995.
- U.S. DoD awarded contracts for development of free compiler.

Ada overview

- Good overview of history and characteristics of Ada:
  Ada 95 in Context, by Michael Feldman
  (http://www.seas.gw.edu/~csci190/spring03/handbook.pdf)

Did Ada succeed?

- As a unified programming language?

  No way: DoD initially mandated use of Ada for new projects, but waivers were widely granted and the mandate was withdrawn in the 1990s

- Technically?

  Certainly: It has found its niche in high-integrity applications (avionics, air traffic control, safety systems, Swiss bank)

gnat

- Team at NYU (Prof. Robert Dewar) obtained compiler contract for several platforms, using gcc as basis.
- On PC, OS/2 only powerful OS available (32 bit)
- Funded by DoD until 1994

AdaCore

- In August 1994, the gnat team founded AdaCore Technologies to further develop and market the gnat Ada technology on a commercial basis
- Now well established Ada vendor supplying compilers to Boeing, Airbus, BAe, Lockheed-Martin etc.
- Compiler still open source (gcc)

gnat on OS/2

- Following the rise of Windows NT based OSs, AdaCore switched from OS/2 to Windows NT as the PC environment around 2001.
- Latest gnat binaries for OS/2 (v. 3.14p, 3.15p) contributed in 2002 by Dave Parsons
- Although not the latest and greatest, still perfectly usable as an Ada compilation system.

Where to obtain gnat for OS/2

- ftp://ftp.cs.kuleuven.be/pub/Ada-Belgium/mirrors/gnu-ada/OLD/3.14p
- ftp://ftp.cs.kuleuven.be/pub/Ada-Belgium/mirrors/gnu-ada/3.15p
- Do not use the versions on Hobbes; these are too old (3.09 and 3.12)

Ada at Fokker

- Aircraft and engine performance programs for advanced design, running on mainframes (Algol on DEC10, Pascal and Ada 83 on VAX).
- Ended by bankruptcy in March 1996

Switch to Ada 95 on OS/2

- PCs powerful enough to replace mainframes arrived just in time.
- Installed OS/2 Warp (100 guilders), bought 12 MB extra memory (1200 guilders), and started using gnat (free) on a 50 MHz PC.
- Early gnat versions gave lots of problems. Very good (free) support from AdaCore.
- gnat 3.14p pretty good

Warpstock Wonderplane

Performance Information

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$Revision: $ $Date: $

Contents

Abbreviations

ASD	Accelerate-Stop Distance
ASDA	Accelerate-Stop Distance Available
CAS	Calibrated Airspeed
EAS	Equivalent Airspeed
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FL	Flight level
ICAO	International Civil Aviation Organization
ISA	International Standard Atmosphere
JAA	Joint Aviation Authorities
JAR	Joint Aviation Requirements
LD	Landing Distance
LDA	Landing Distance Available
MLW	Maximum Landing Weight
MMO	Maximum Operating Mach number
MRW	Maximum Ramp Weight
MTOW	Maximum Take-off Weight
MZFW	Maximum Zero-Fuel Weight
OAT	Outside Air Temperature (Ambient temperature)
OEW	Operating Empty Weight
ROC	Rate of Climb
ROD	Rate of Descent
RVSM	Reduced Vertical Separation Minimum
S/L	Sea Level
TAS	True Airspeed
TOD	Take-off Distance
TODA	Take-off Distance Available
TOR	Take-off Run
TORA	Take-off Run Available
VMO	Maximum Operating Speed
WAT	Weight, Altitude, Temperature

Chapter 1

Aircraft Characteristics

The Warpstock Wonderplane is a modern medium-range airliner powered by two turbofan engines. A three-view drawing is shown in figure 1.1.

The main characteristics are as follows:

Powerplant		
Engine type	OS/2 Warp	
Number of engines	2	
Maximum take-off thrust, each	16 000 lb	
Weights		
Operational empty weight (typical)	26 500 kg	58 422 lb
Maximum structural payload (typical)	11 100 kg	24 471 lb
Maximum zero-fuel weight	37 600 kg	82 893 lb
Maximum landing weight	40 000 kg	88 184 lb
Maximum take-off weight	46 000 kg	101 411 lb
Maximum ramp weight	46 250 kg	101 962 lb
Fuel capacity		
By volume	13 365 liter	3 531 USg
By weight (at 0.810 kg/liter, 6.76 lb/USg)	10 731 kg	23 658 lb
Operating limitations		
Maximum operating altitude	35 000 ft	
Maximum operating speed V_{MO}	320 kts CAS	
Maximum operating Mach number M_{MO}	0.80	

Note:

Everything up to this point is prepared manually in advance of the atuomatic process. From the next chapter onwards, all pages are generated automatically. This includes the fragments of LaTeX code that form the chapters and all performance graphs.

To be supplied later.

Figure 1.1: Three-view drawing of Warpstock Wonderplane.

Chapter 2

Stall speed

Introduction

This is a call to the LaTeX macro `\Intro`. This can optionally be defined in the preamble of the file to provide any text needed to serve as an introduction to this chapter.

The interesting thing is that while the text is defined in the first (manually prepared) part of the file, it actually appears much later in the automatically-generated part.

Assumptions

The stall speed is based on the minimum speed reached during the stall manoeuvre.

Figures

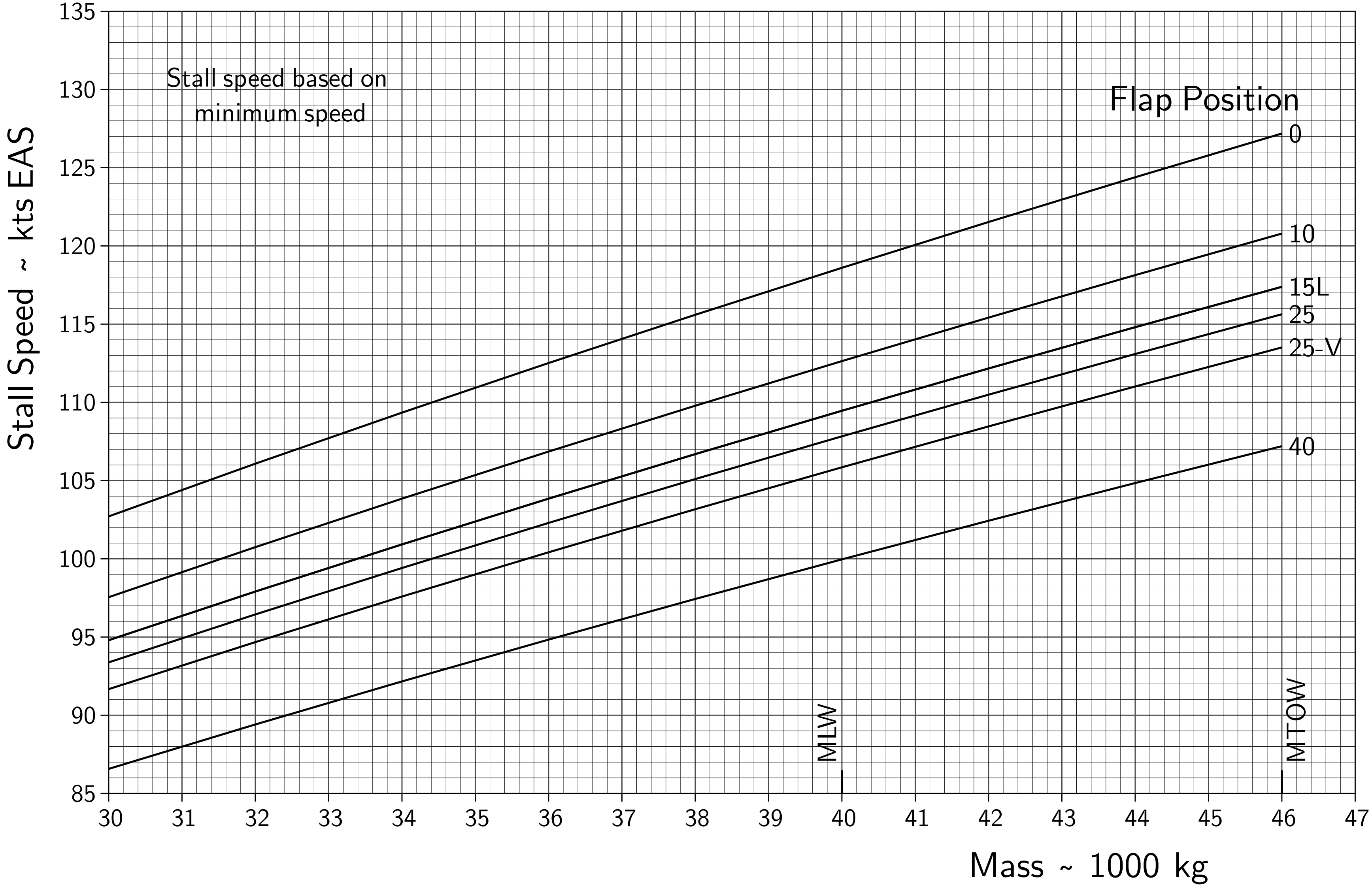

Figure 2.1: Stall speed for all flap positions.

Chapter 3

Take-off

Introduction

This is a call to the LaTeX macro `\Intro`. This can optionally be defined in the preamble of the file to provide any text needed to serve as an introduction to this chapter.

The interesting thing is that while the text is defined in the first (manually prepared) part of the file, it actually appears much later in the automatically-generated part.

Assumptions

Joint Aviation Requirements 25 (Transport Category), without Change 5.
Balanced take-off field length.
Smooth hard-surfaced runway, no slope, no wind.
Anti-icing off.
Net climb with critical engine inoperative and undercarriage retracted.
Net climb gradient is gross gradient diminished by 0.8 %.

Figures

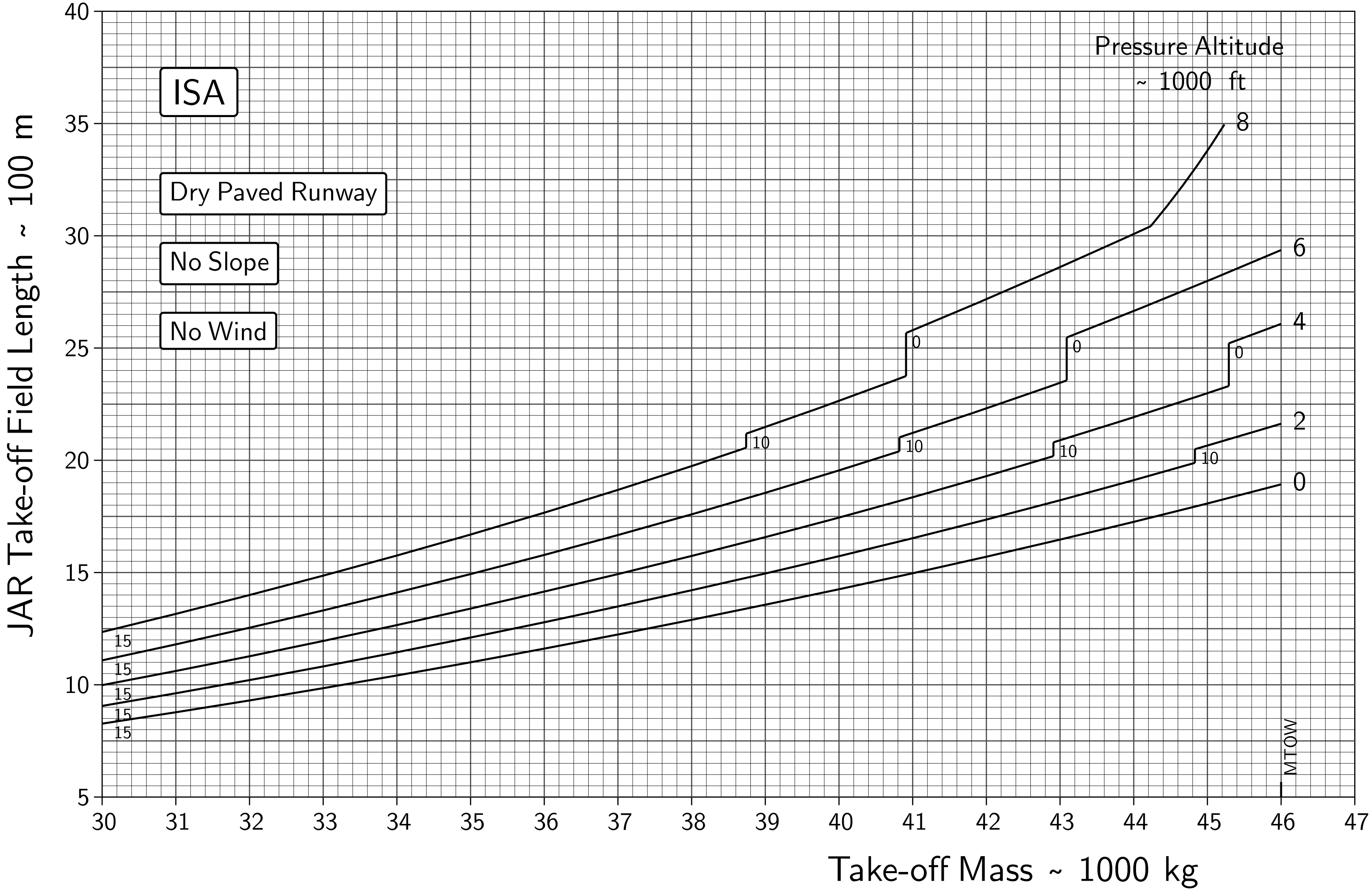

Figure 3.1: Take-off field length, dry runway, at ISA.

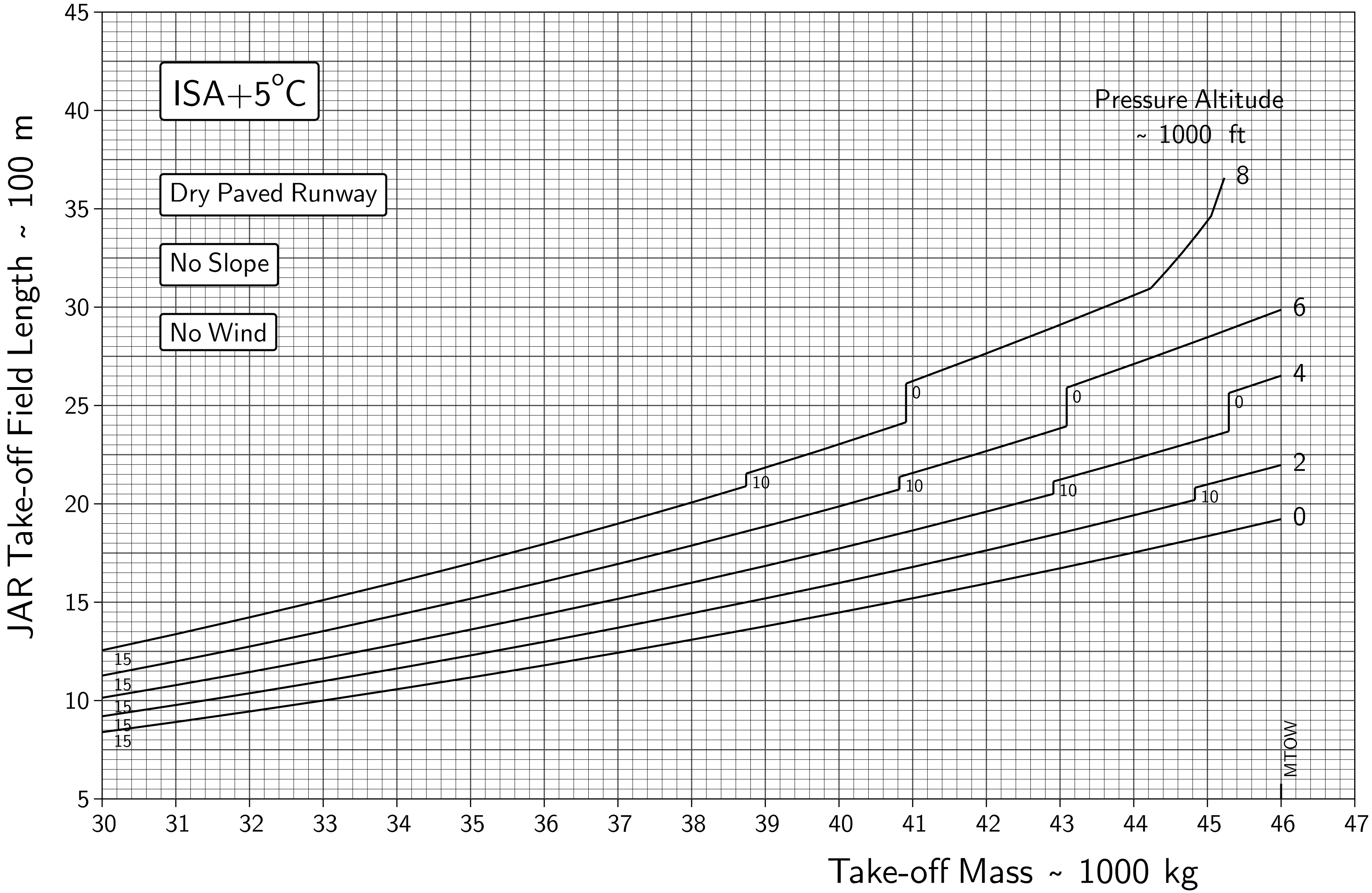

Figure 3.2: Take-off field length, dry runway, at ISA + 5°C.

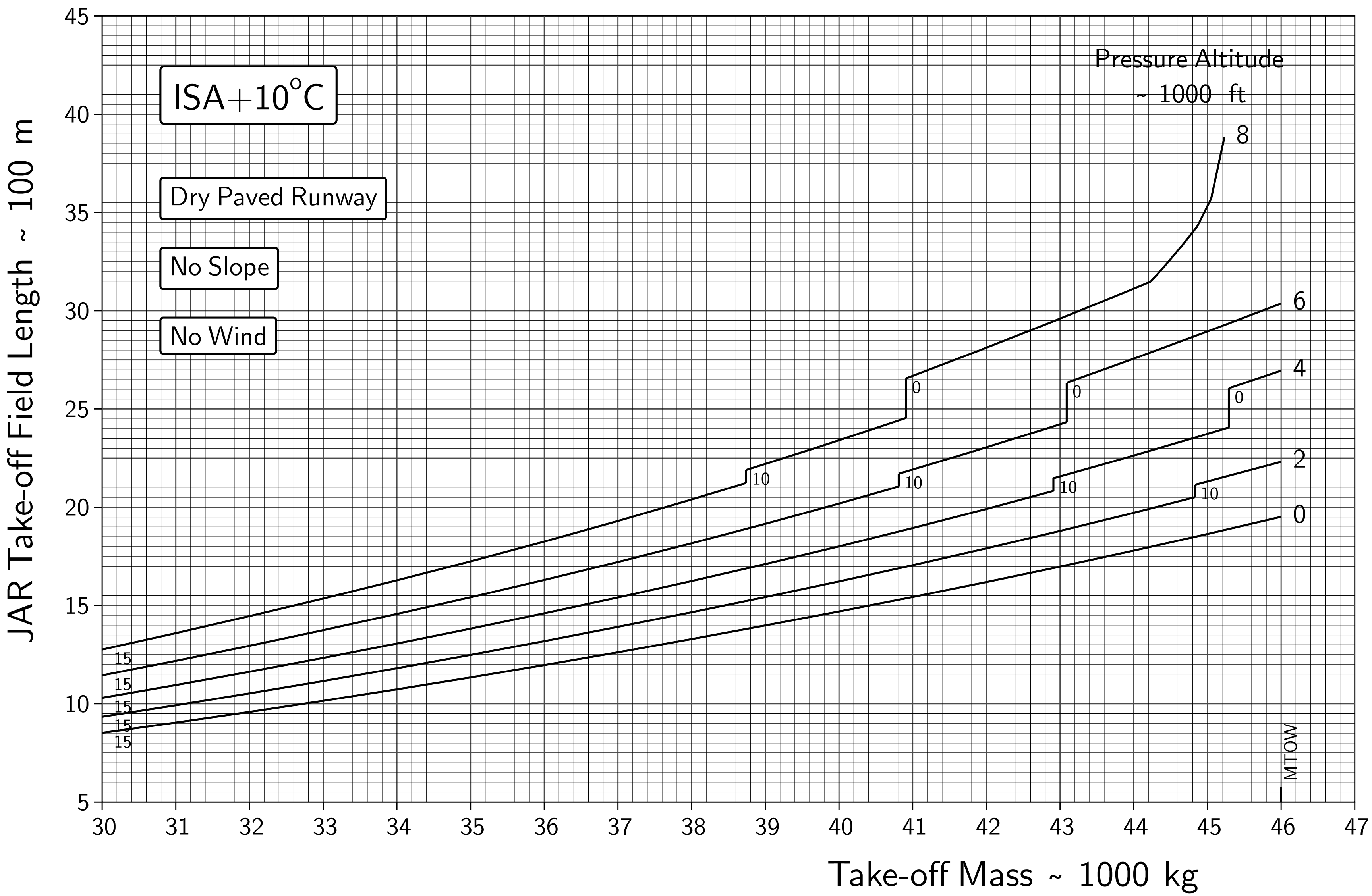

Figure 3.3: Take-off field length, dry runway, at ISA + 10°C.

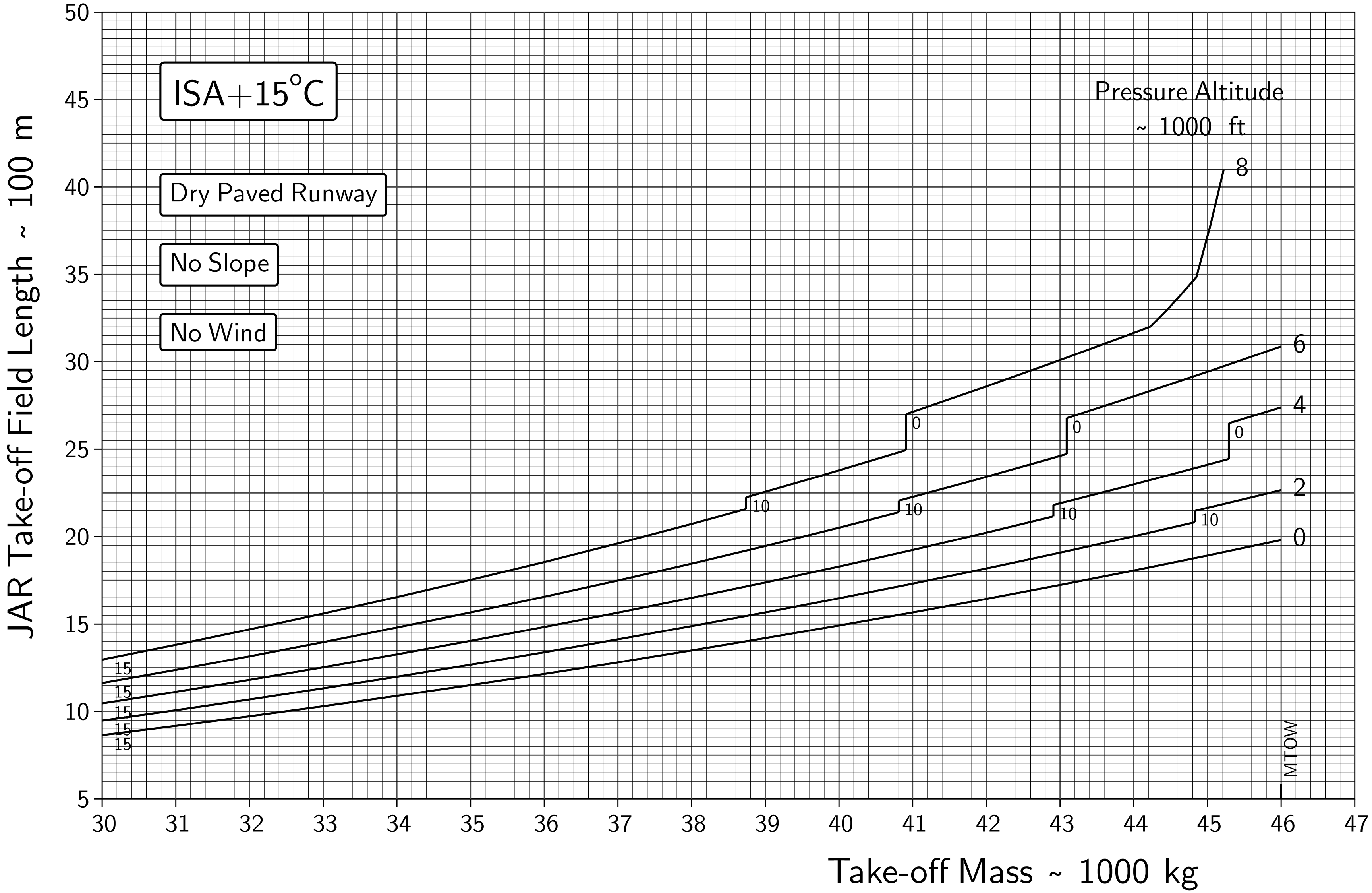

Figure 3.4: Take-off field length, dry runway, at ISA + 15°C.

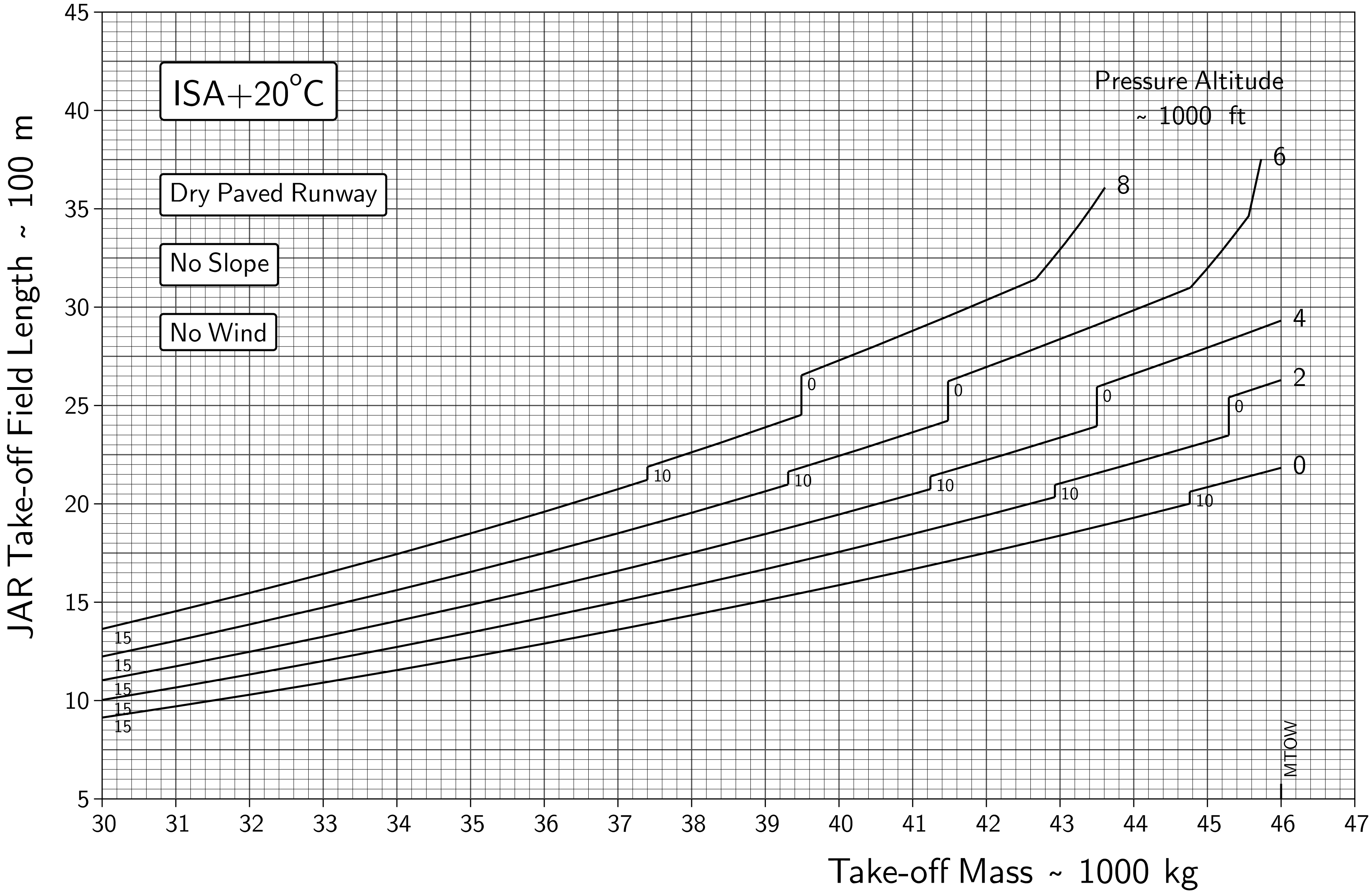

Figure 3.5: Take-off field length, dry runway, at ISA + 20°C.

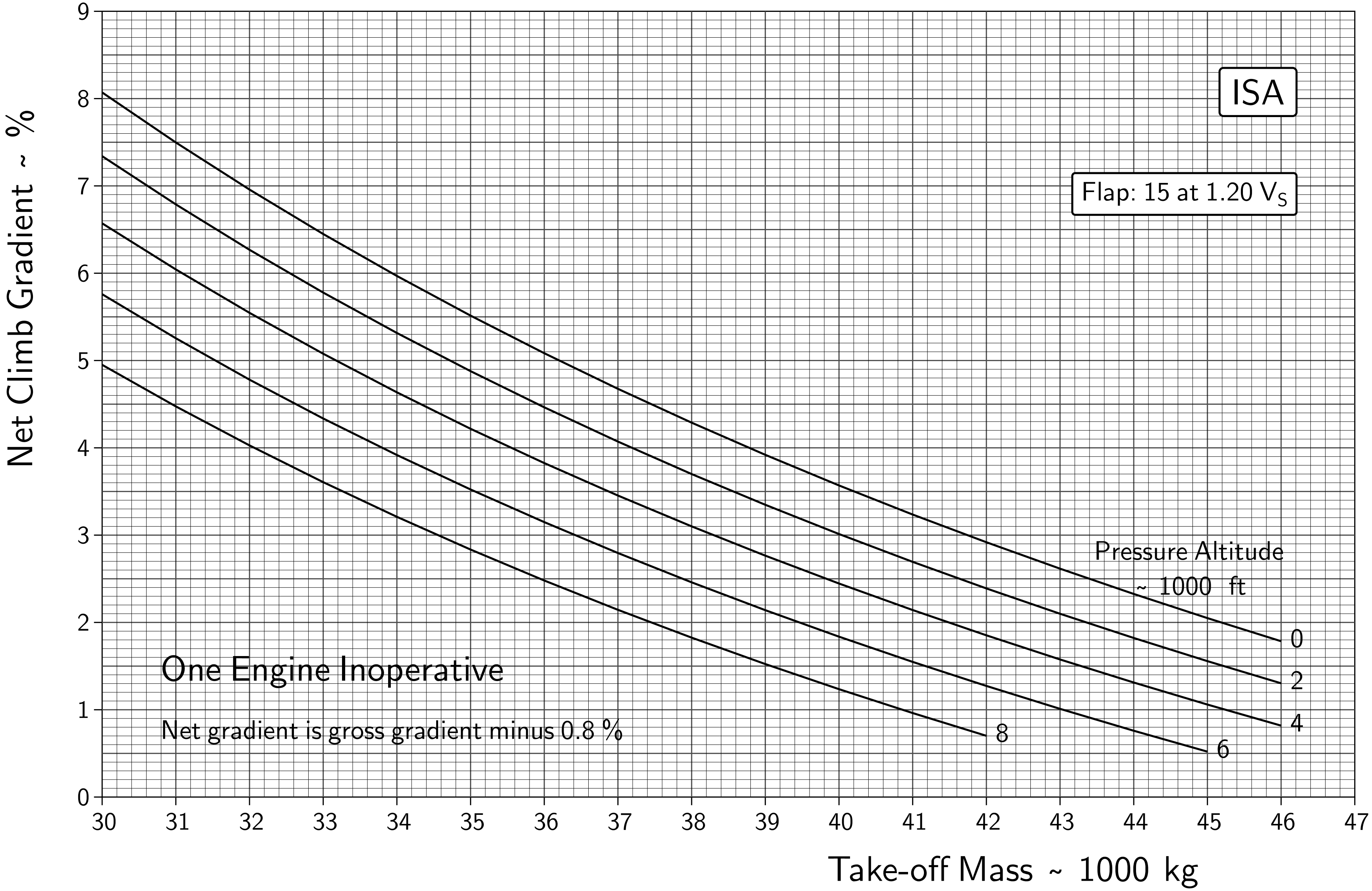

Figure 3.6: Net climb gradient with flap 15 and 1.20 V_S at ISA.

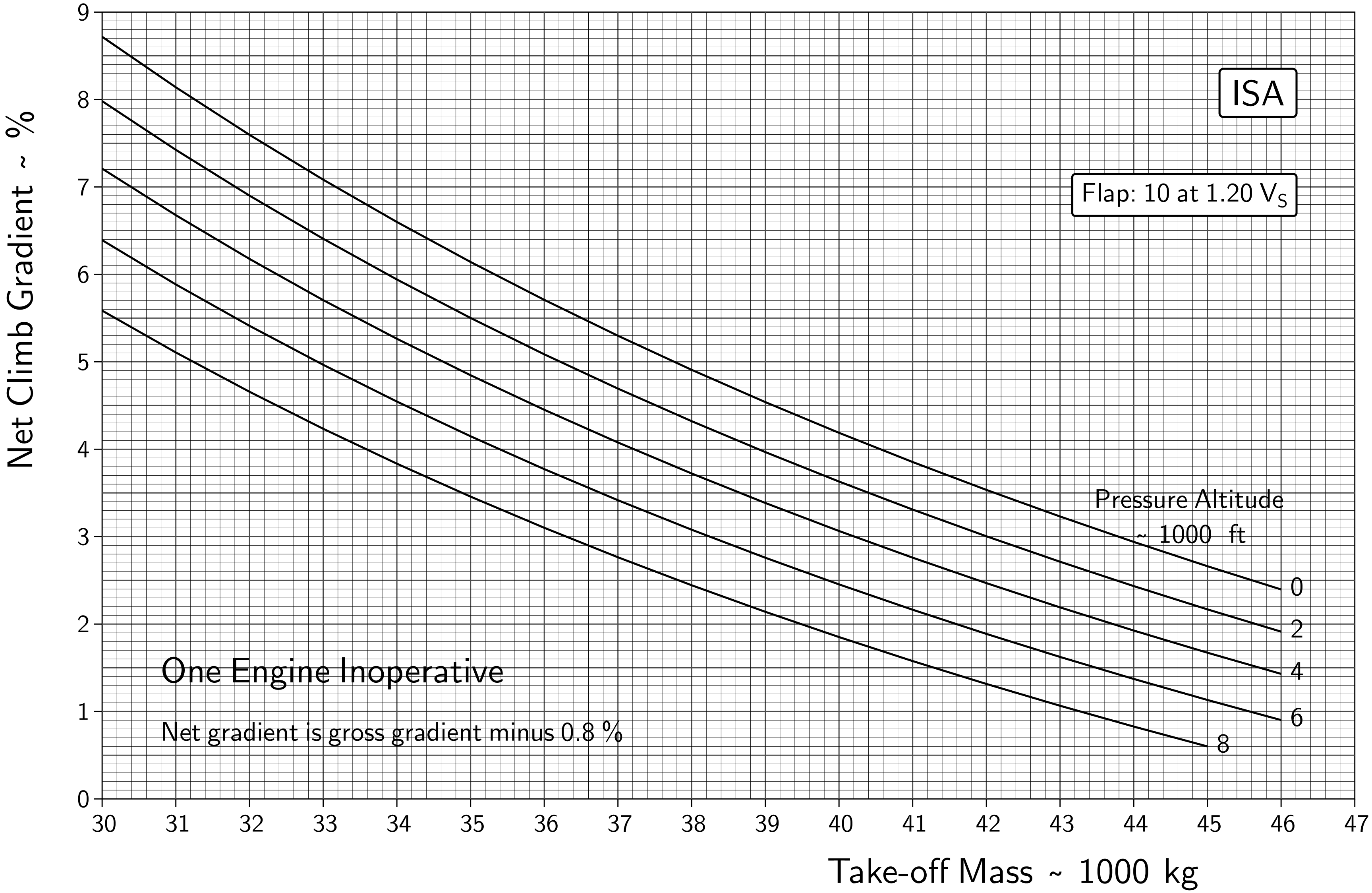

Figure 3.7: Net climb gradient with flap 10 and 1.20 V_S at ISA.

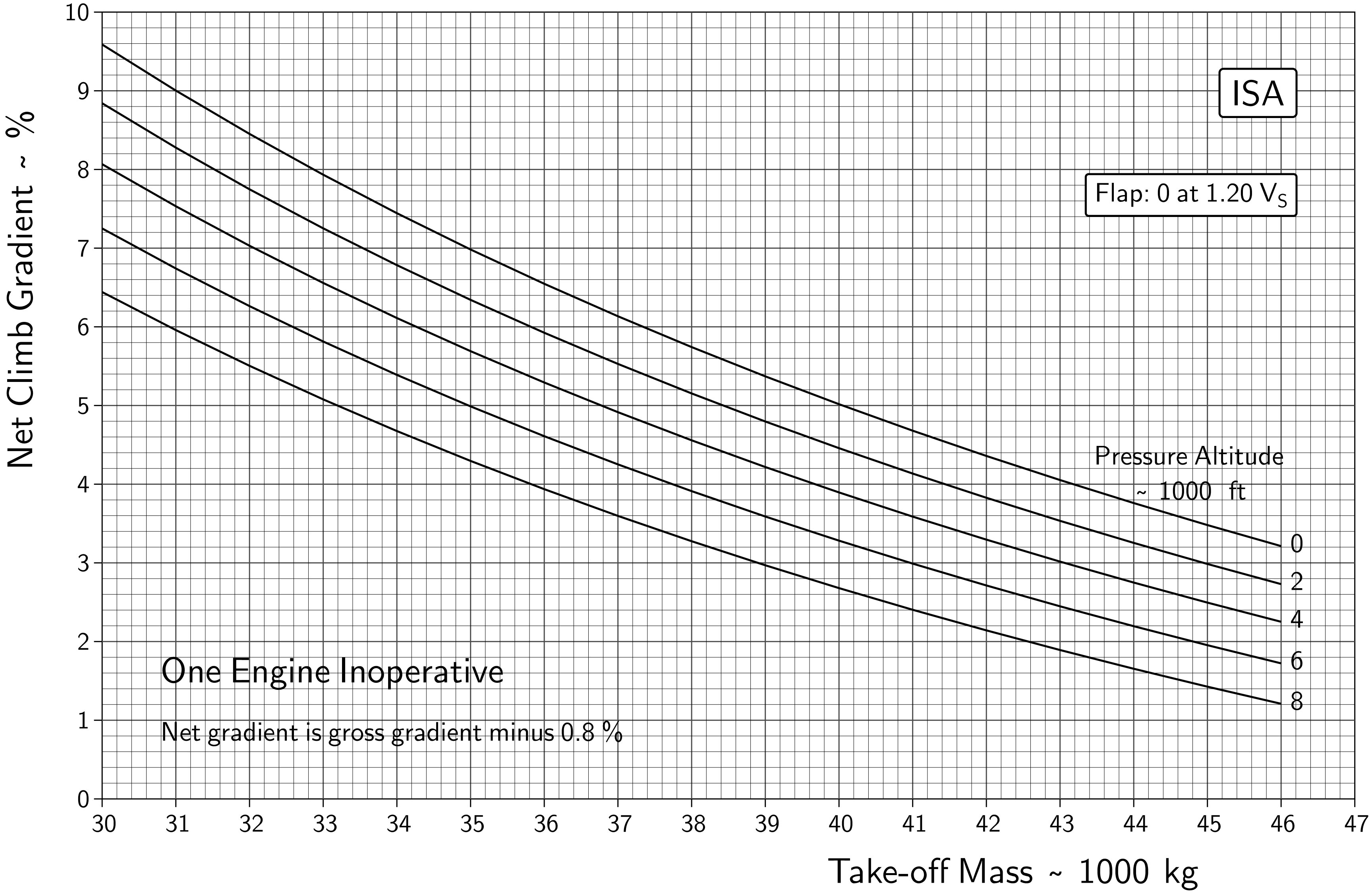

Figure 3.8: Net climb gradient with flap 0 and 1.20 V_S at ISA.

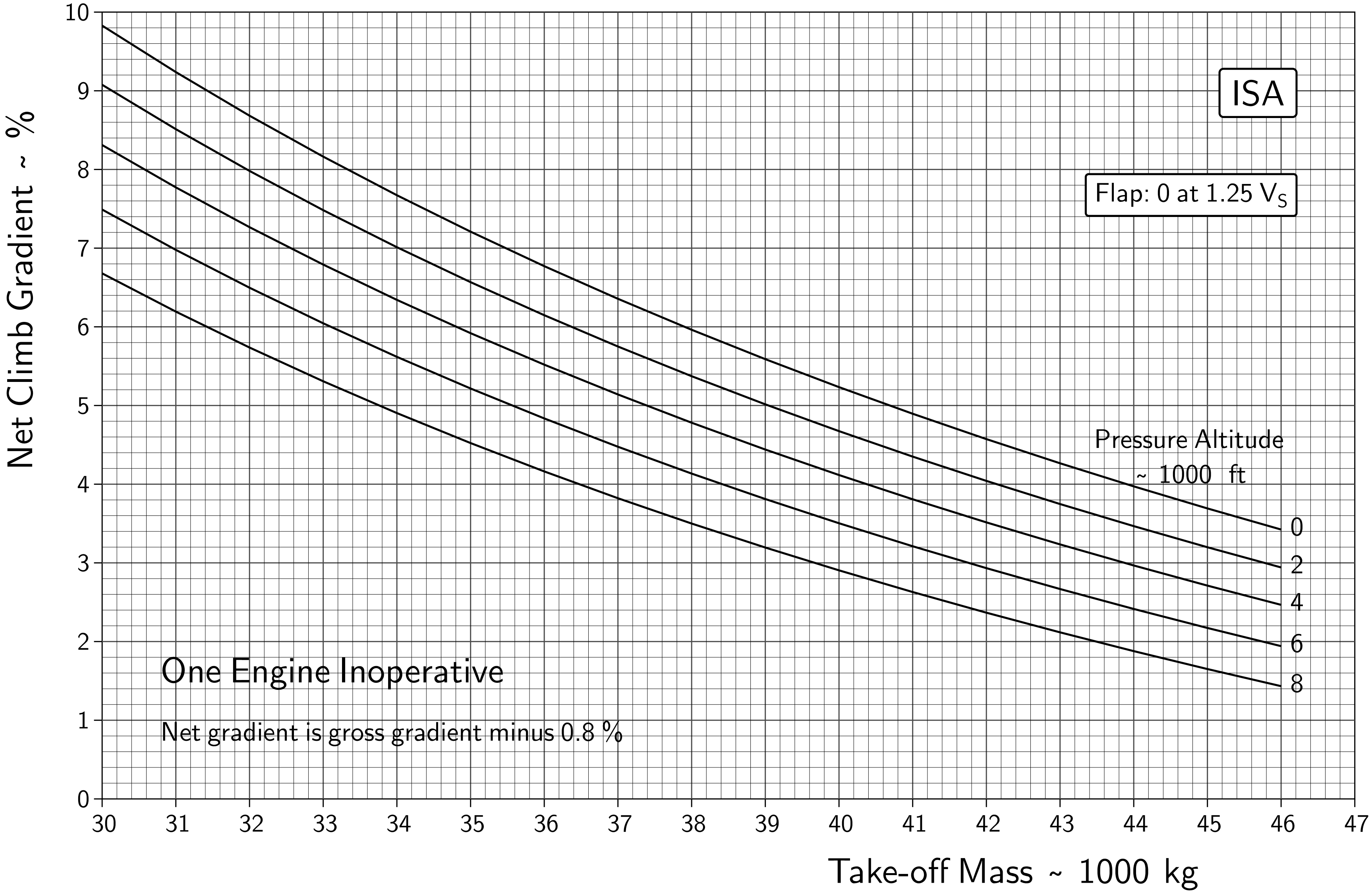

Figure 3.9: Net climb gradient with flap 0 and 1.25 V_S at ISA.

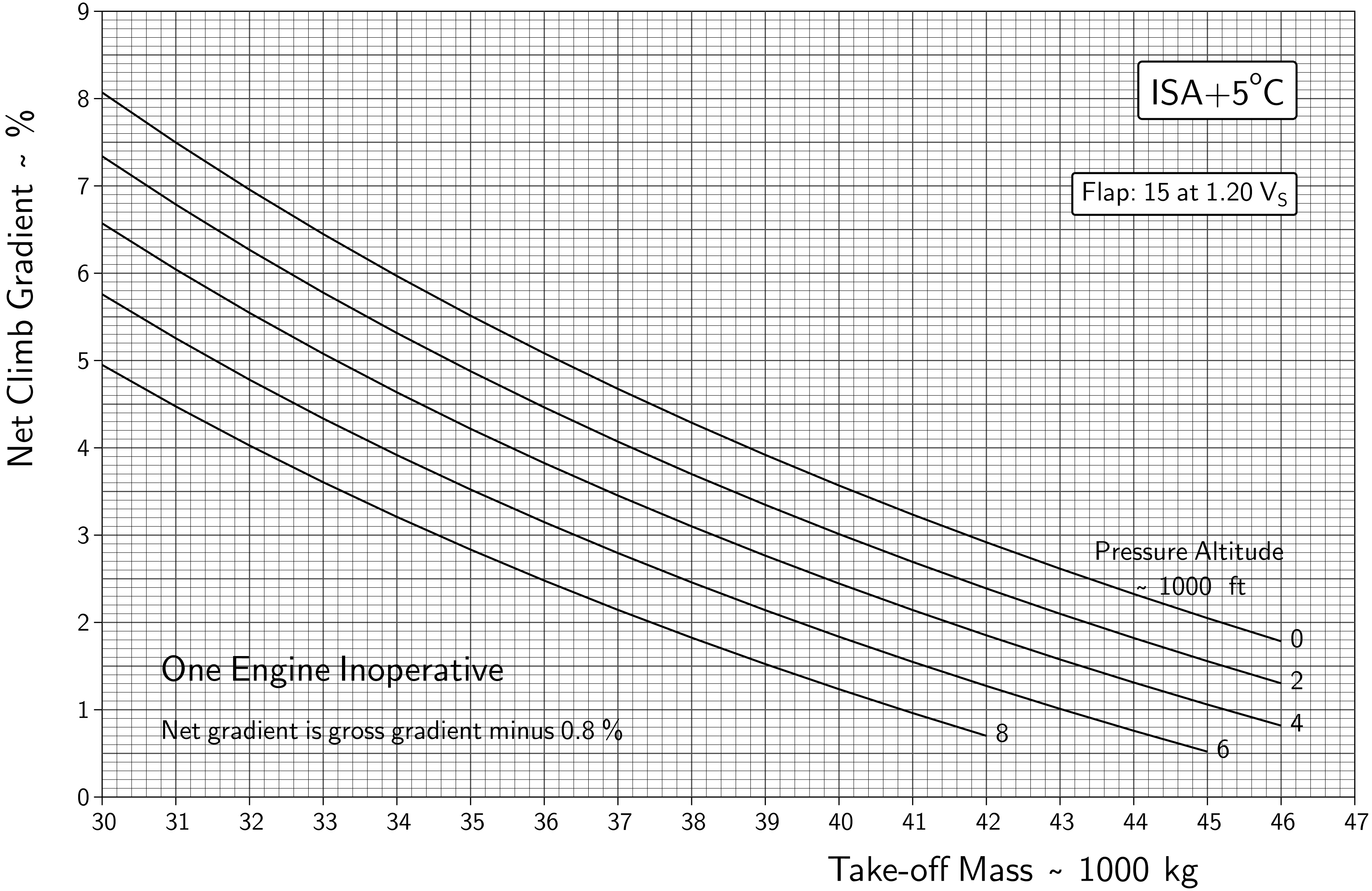

Figure 3.10: Net climb gradient with flap 15 and 1.20 V_S at ISA + 5°C.

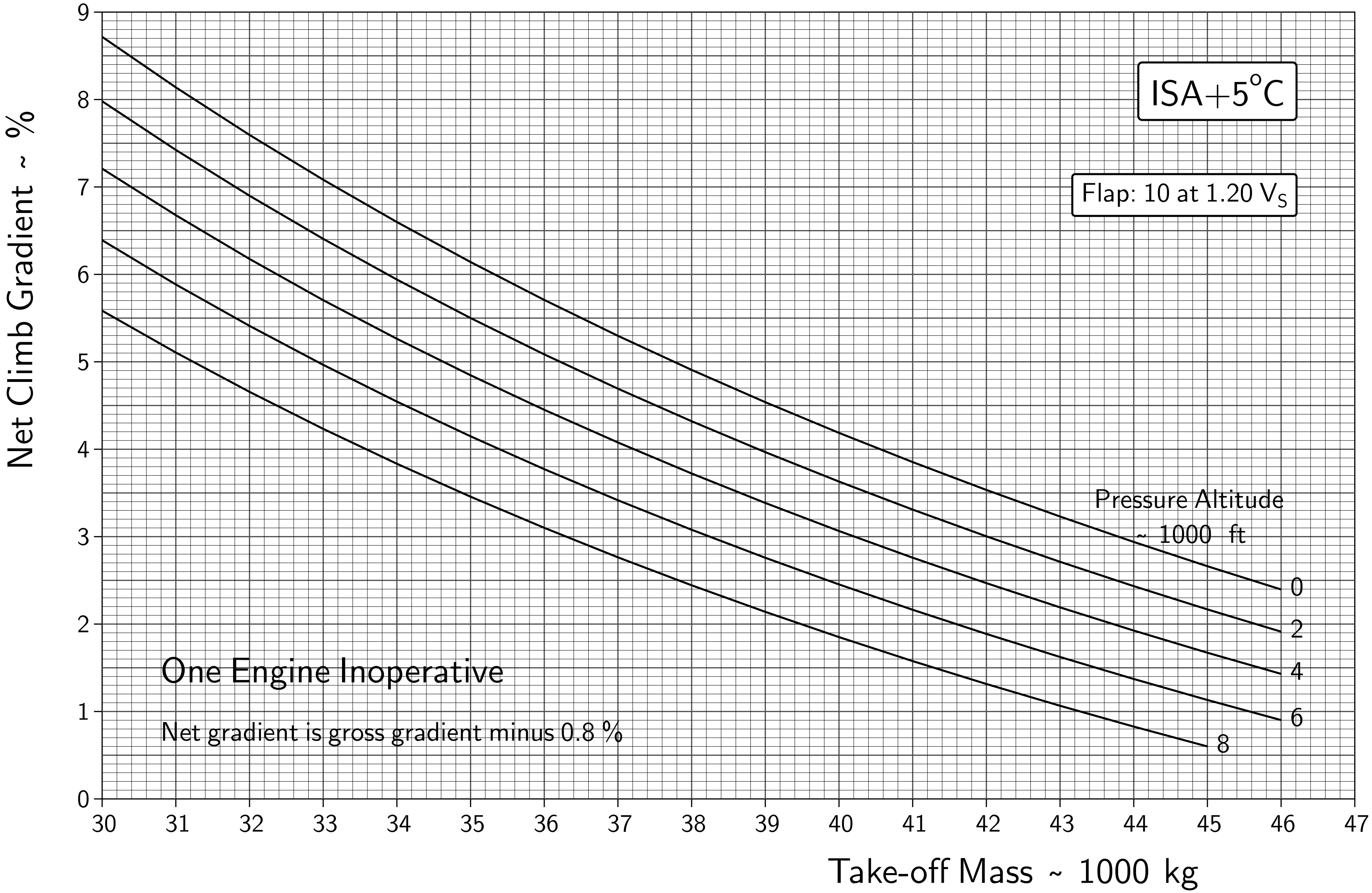

Figure 3.11: Net climb gradient with flap 10 and 1.20 V_S at ISA + 5°C.

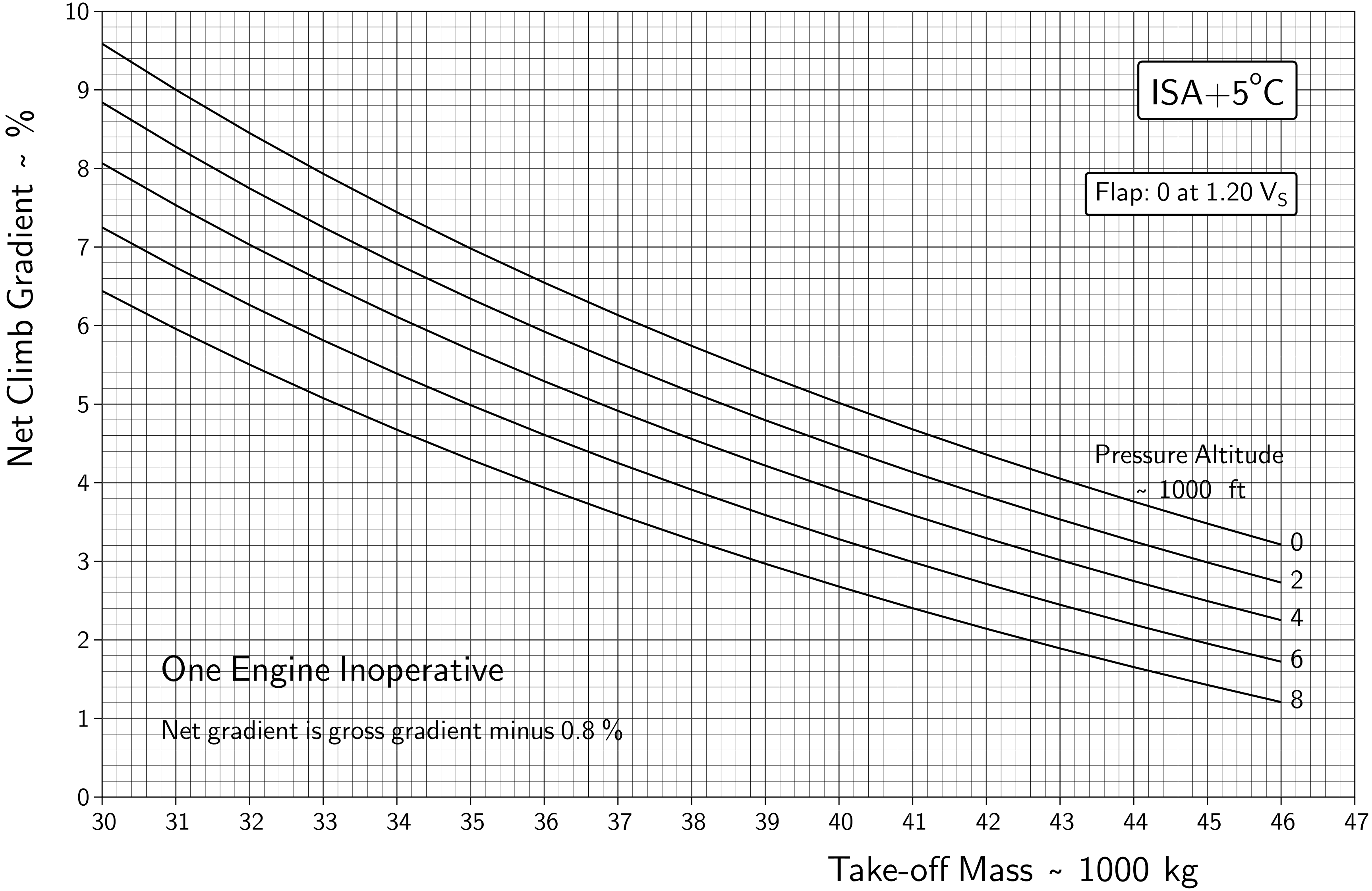

Figure 3.12: Net climb gradient with flap 0 and 1.20 V_S at ISA + 5°C.

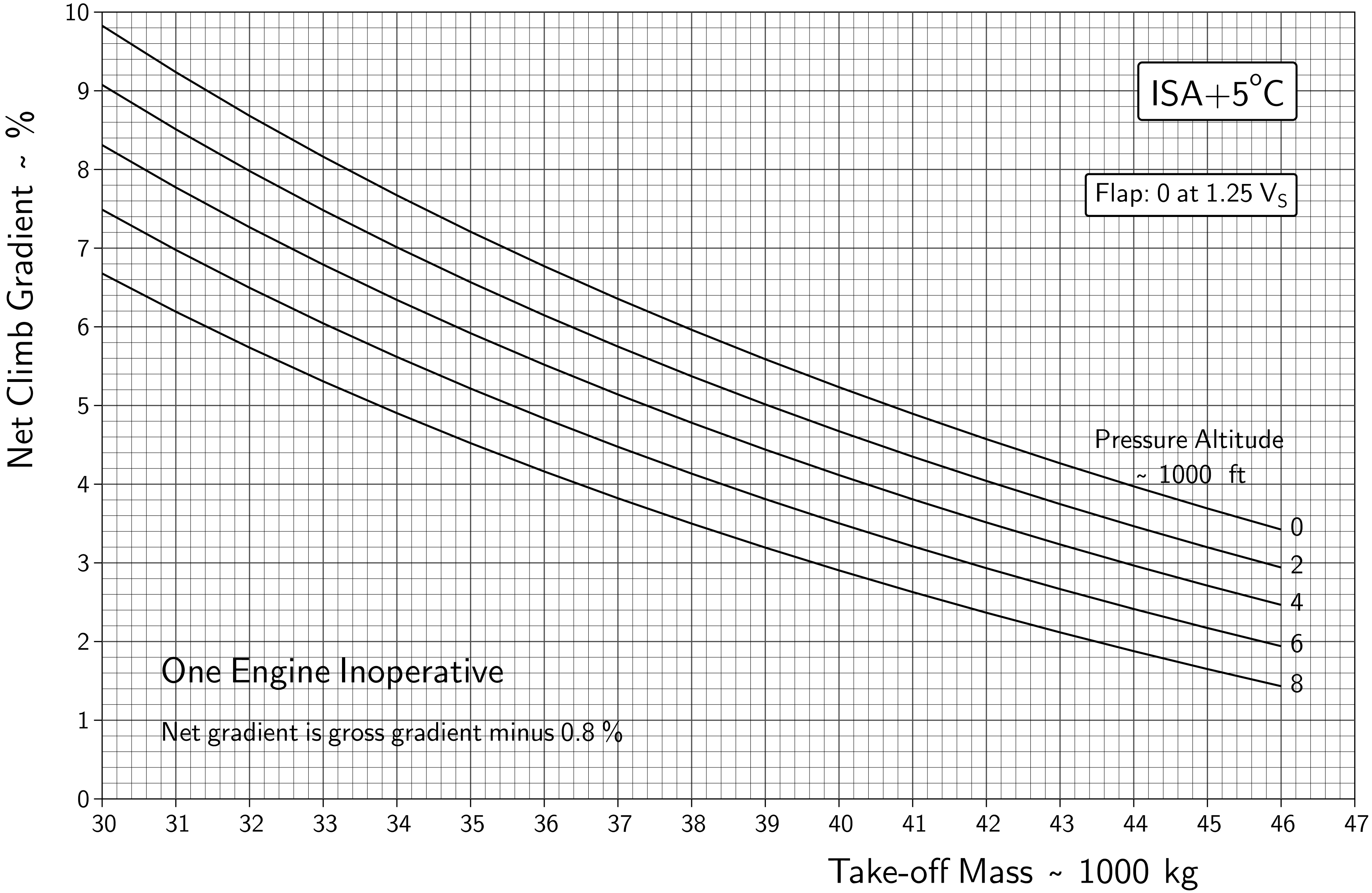

Figure 3.13: Net climb gradient with flap 0 and 1.25 V_S at ISA + 5°C.

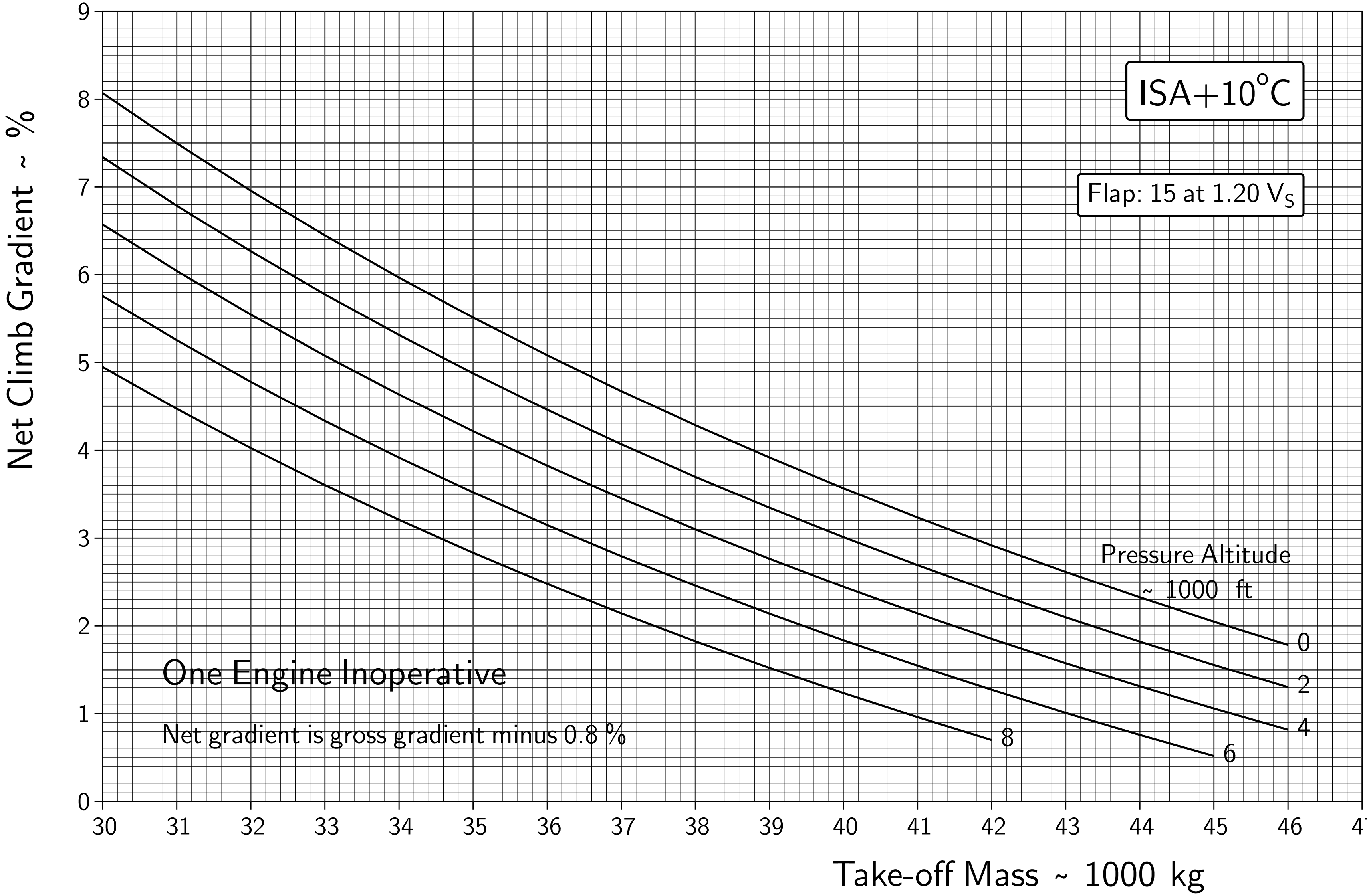

Figure 3.14: Net climb gradient with flap 15 and 1.20 V_S at ISA + 10°C.

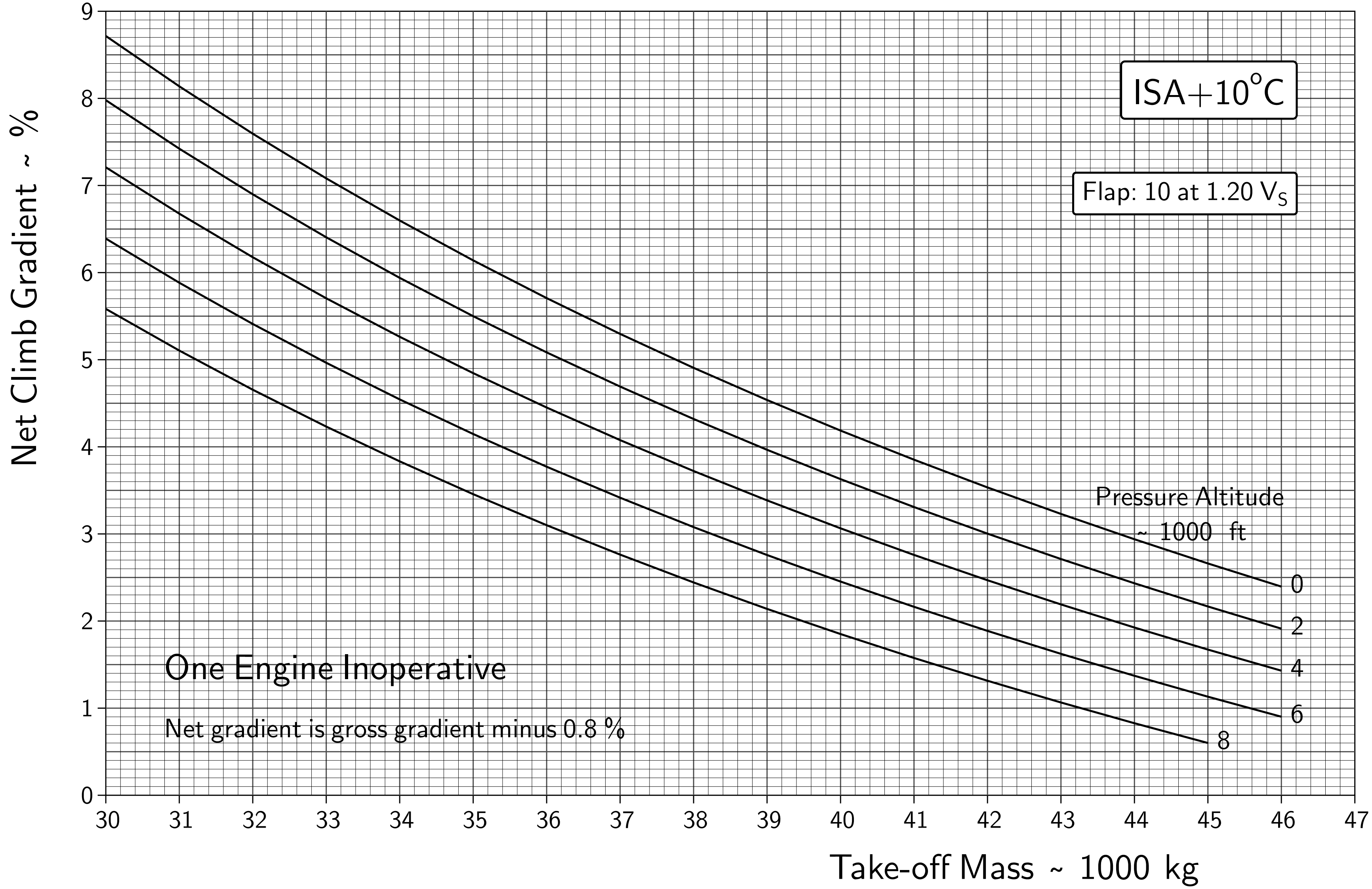

Figure 3.15: Net climb gradient with flap 10 and 1.20 V_S at ISA + 10°C.

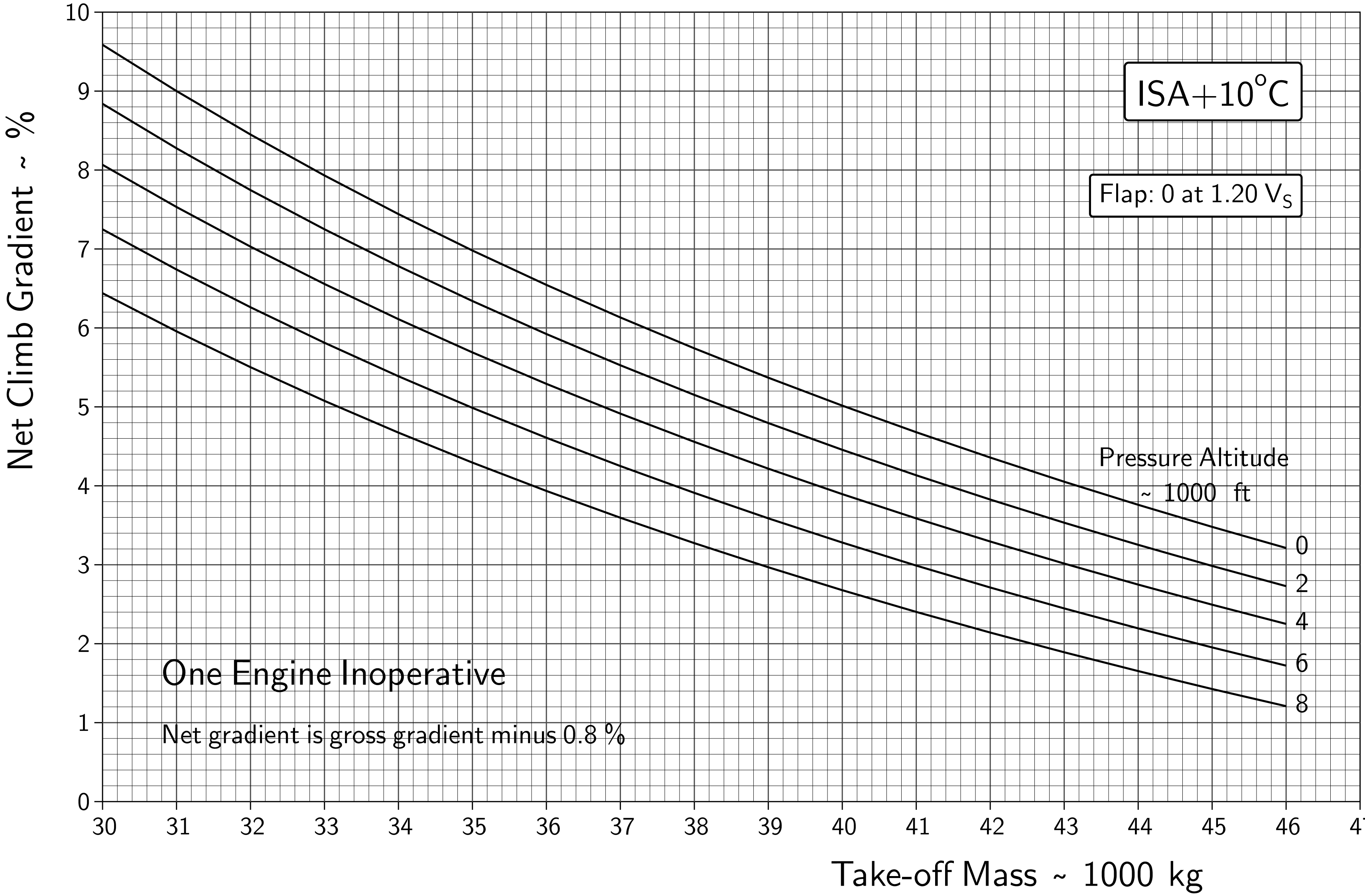

Figure 3.16: Net climb gradient with flap 0 and 1.20 V_S at ISA + 10°C.

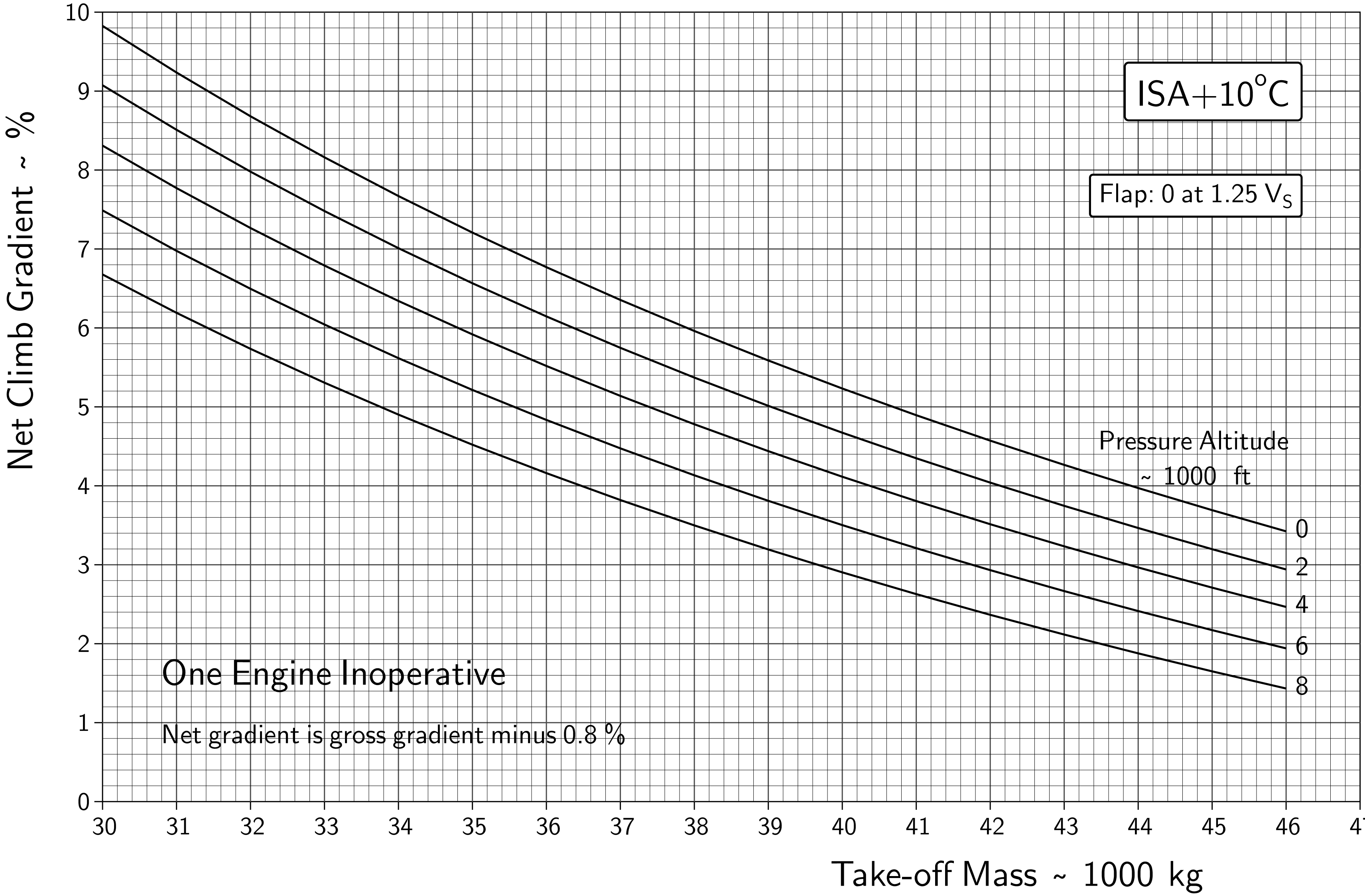

Figure 3.17: Net climb gradient with flap 0 and 1.25 V_S at ISA + 10°C.

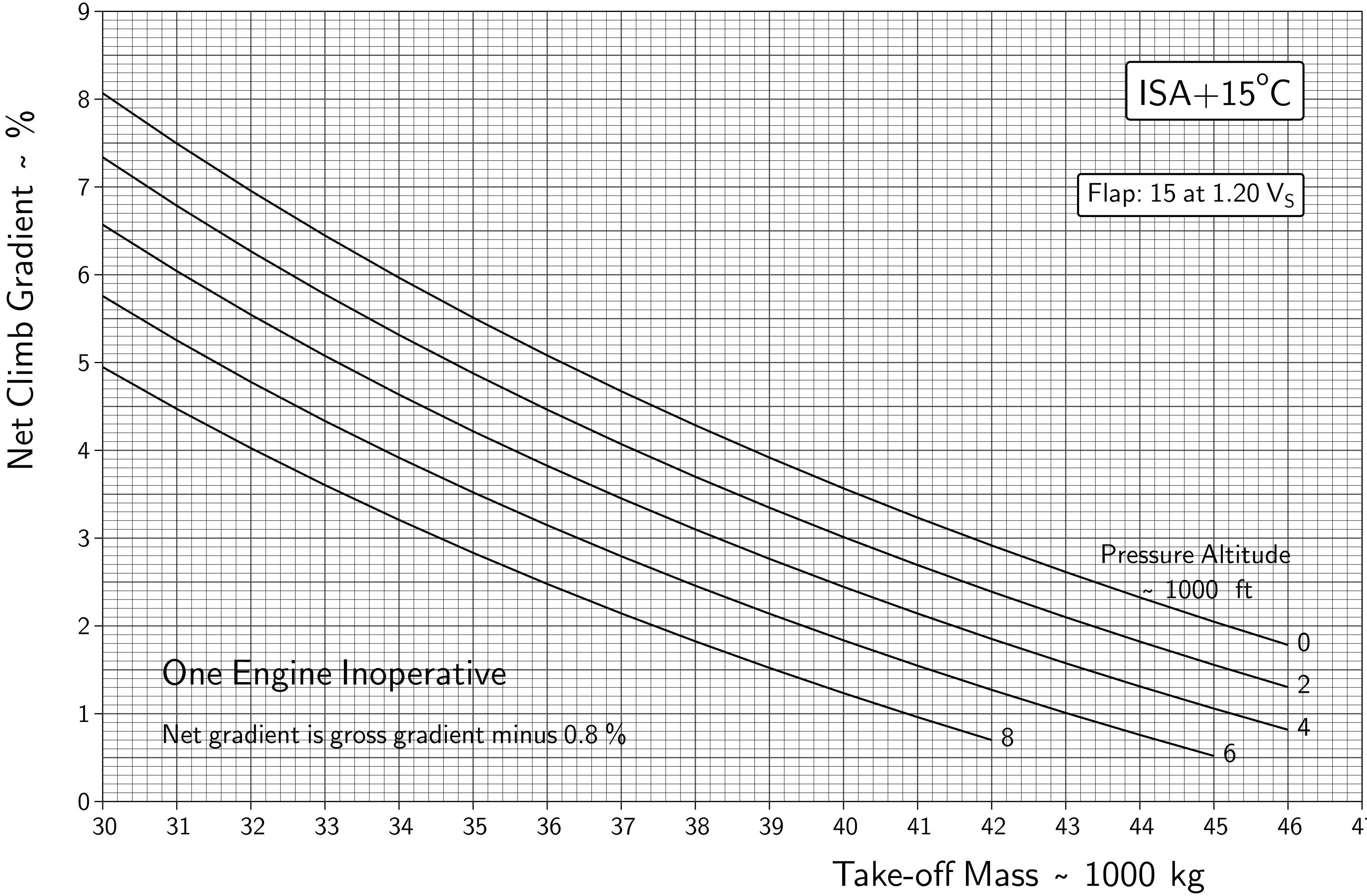

Figure 3.18: Net climb gradient with flap 15 and 1.20 V_S at ISA + 15°C.

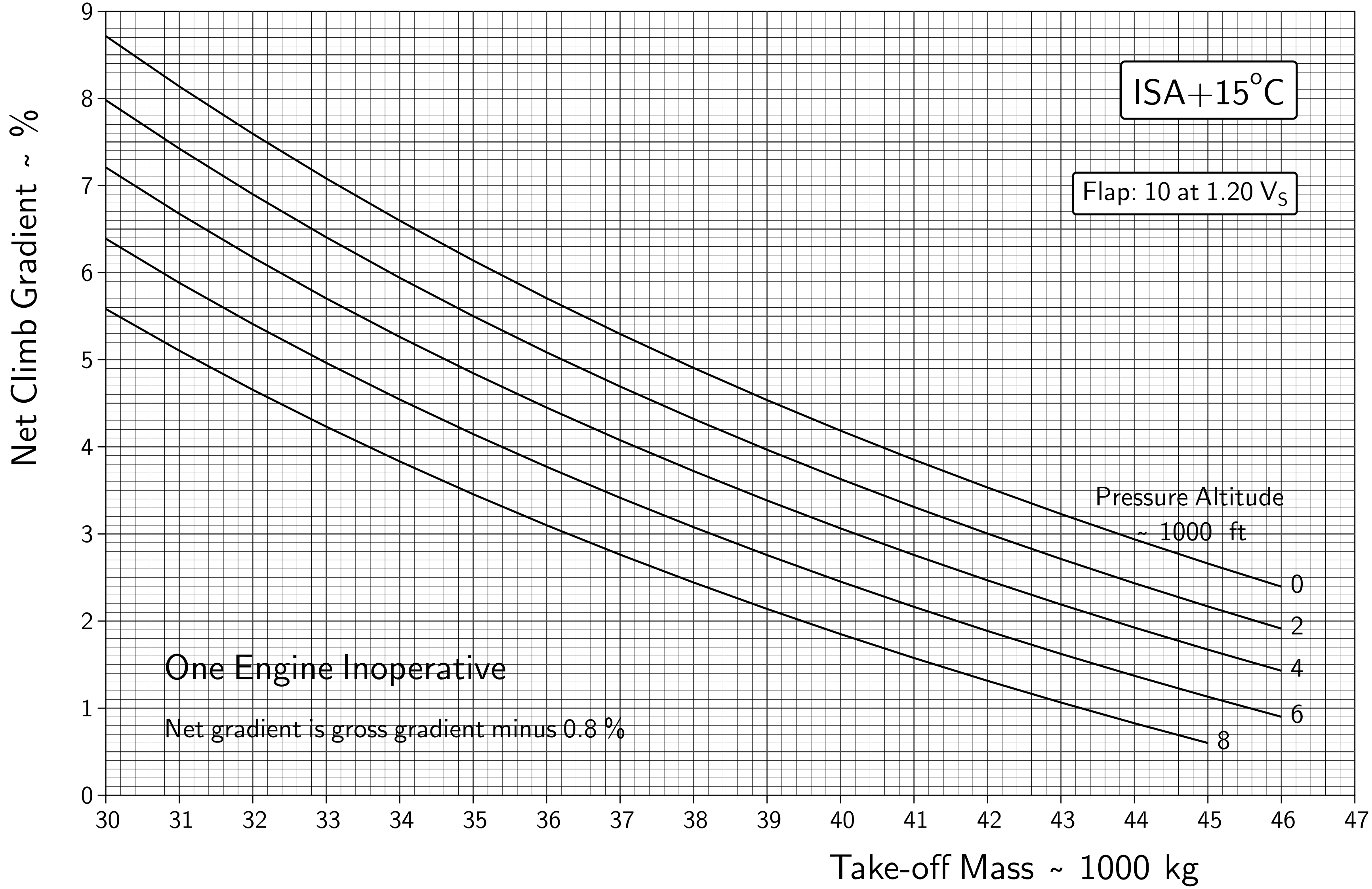

Figure 3.19: Net climb gradient with flap 10 and 1.20 V_S at ISA + 15°C.

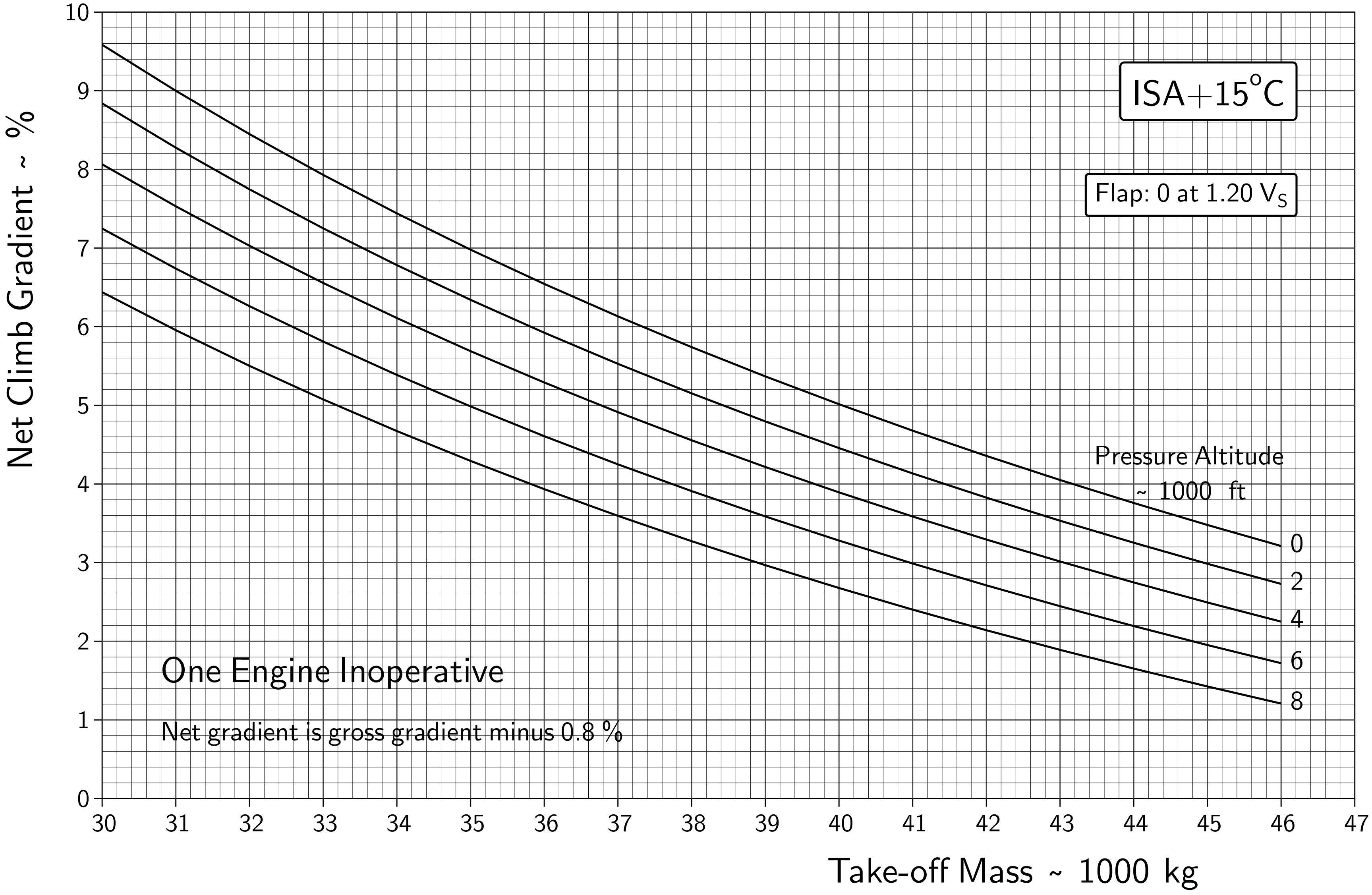

Figure 3.20: Net climb gradient with flap 0 and 1.20 V_S at ISA + 15°C.

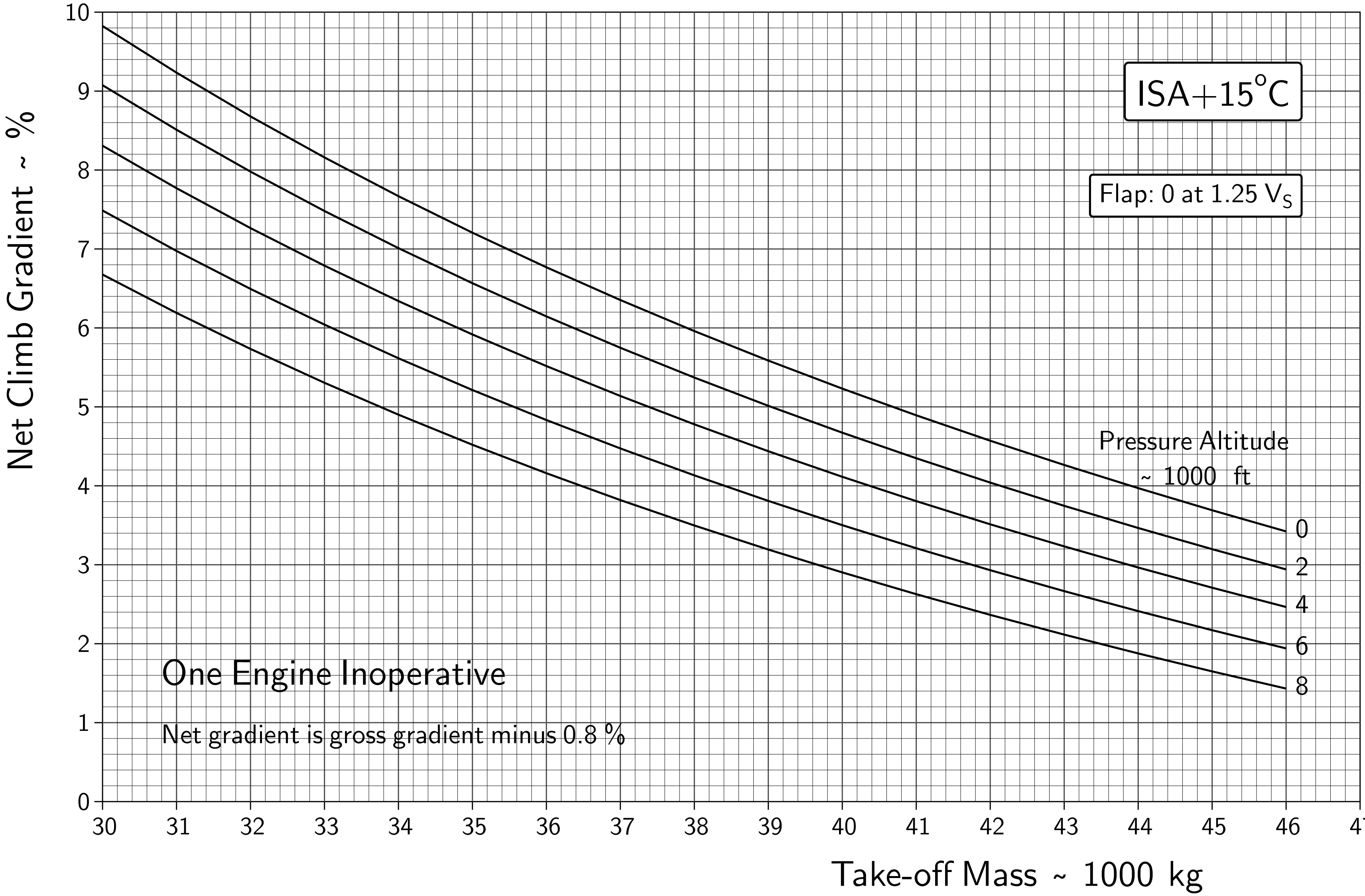

Figure 3.21: Net climb gradient with flap 0 and 1.25 V_S at ISA + 15°C.

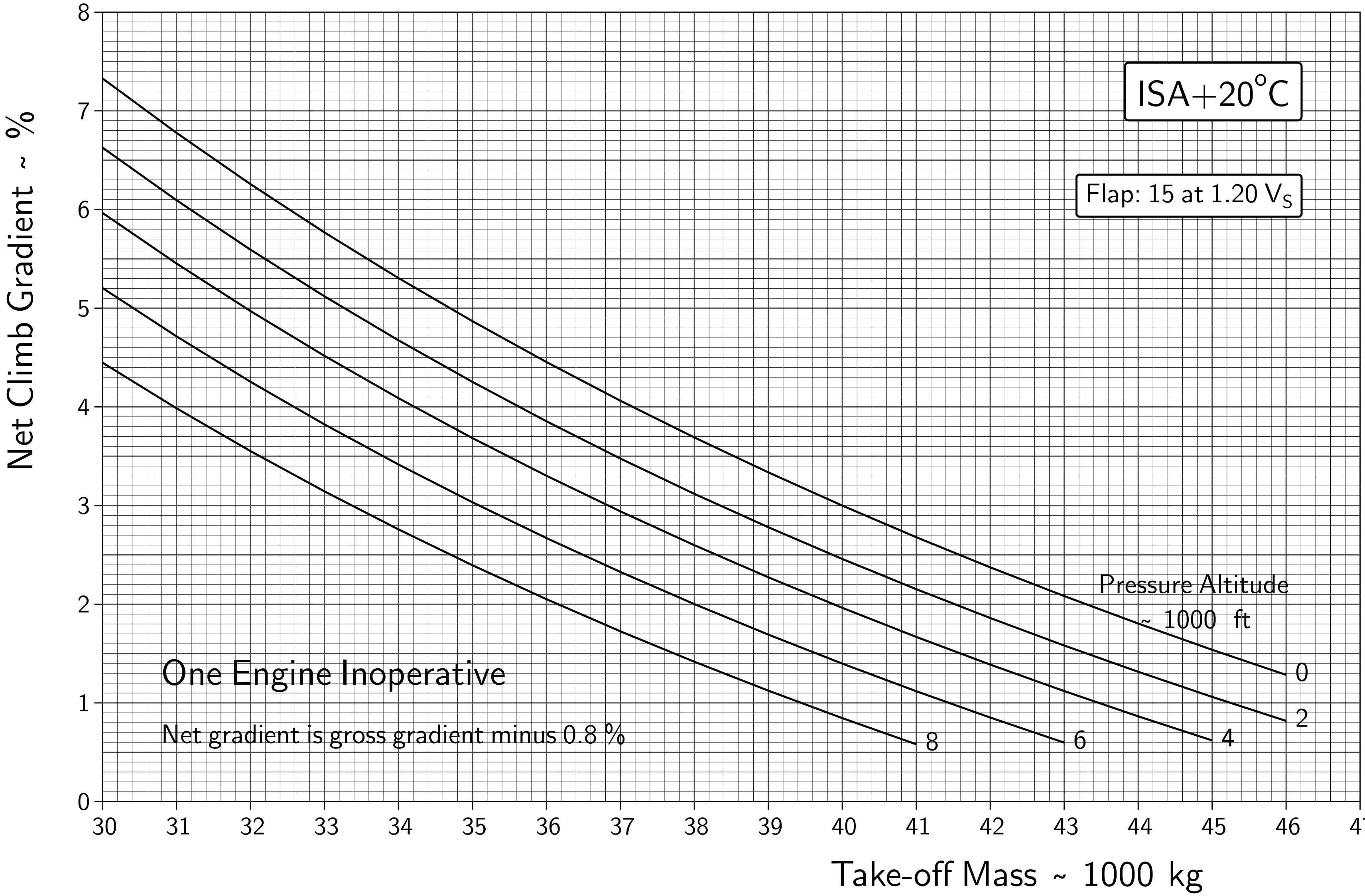

Figure 3.22: Net climb gradient with flap 15 and 1.20 V_S at ISA + 20°C.

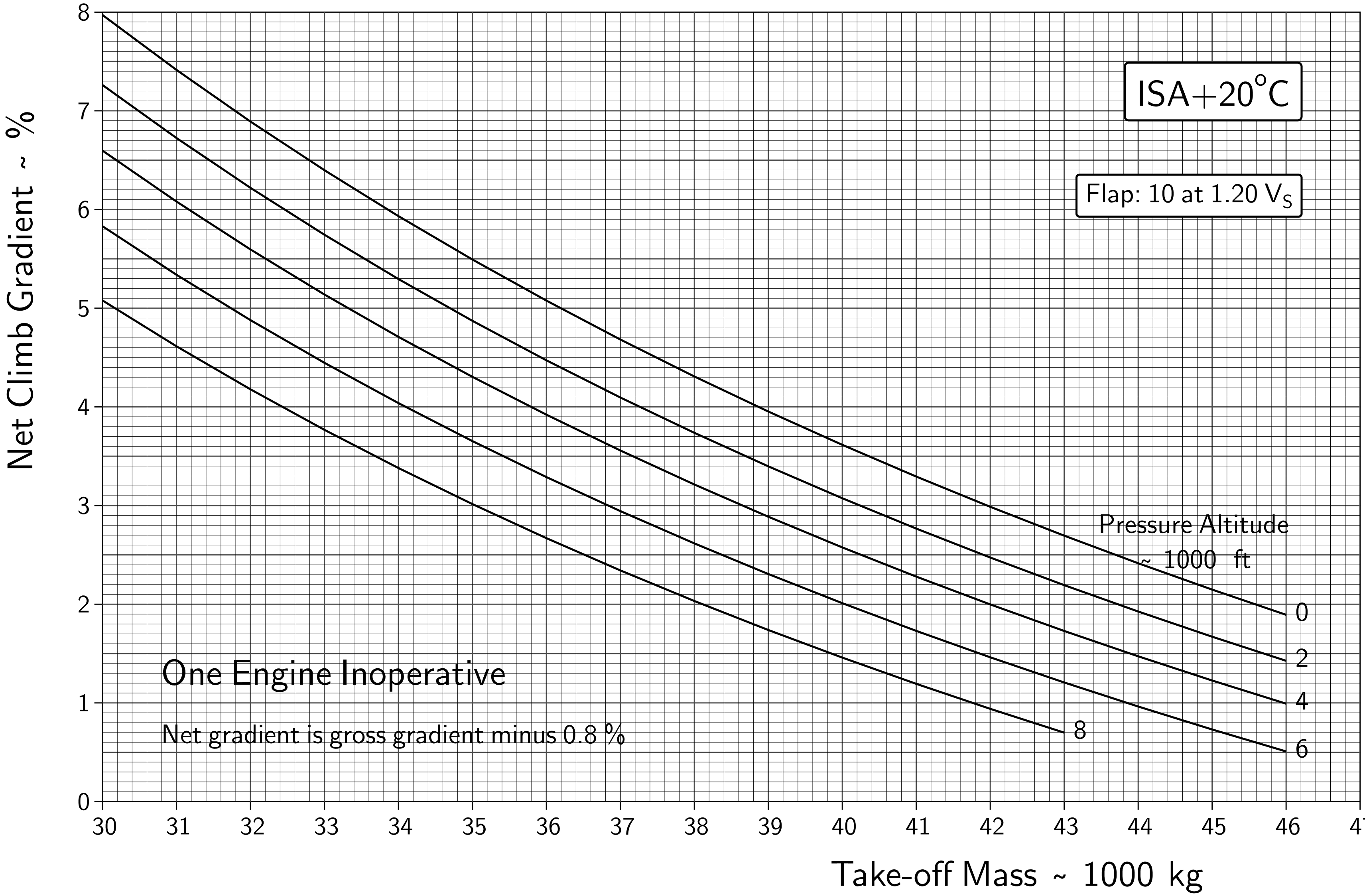

Figure 3.23: Net climb gradient with flap 10 and 1.20 V_S at ISA + 20°C.

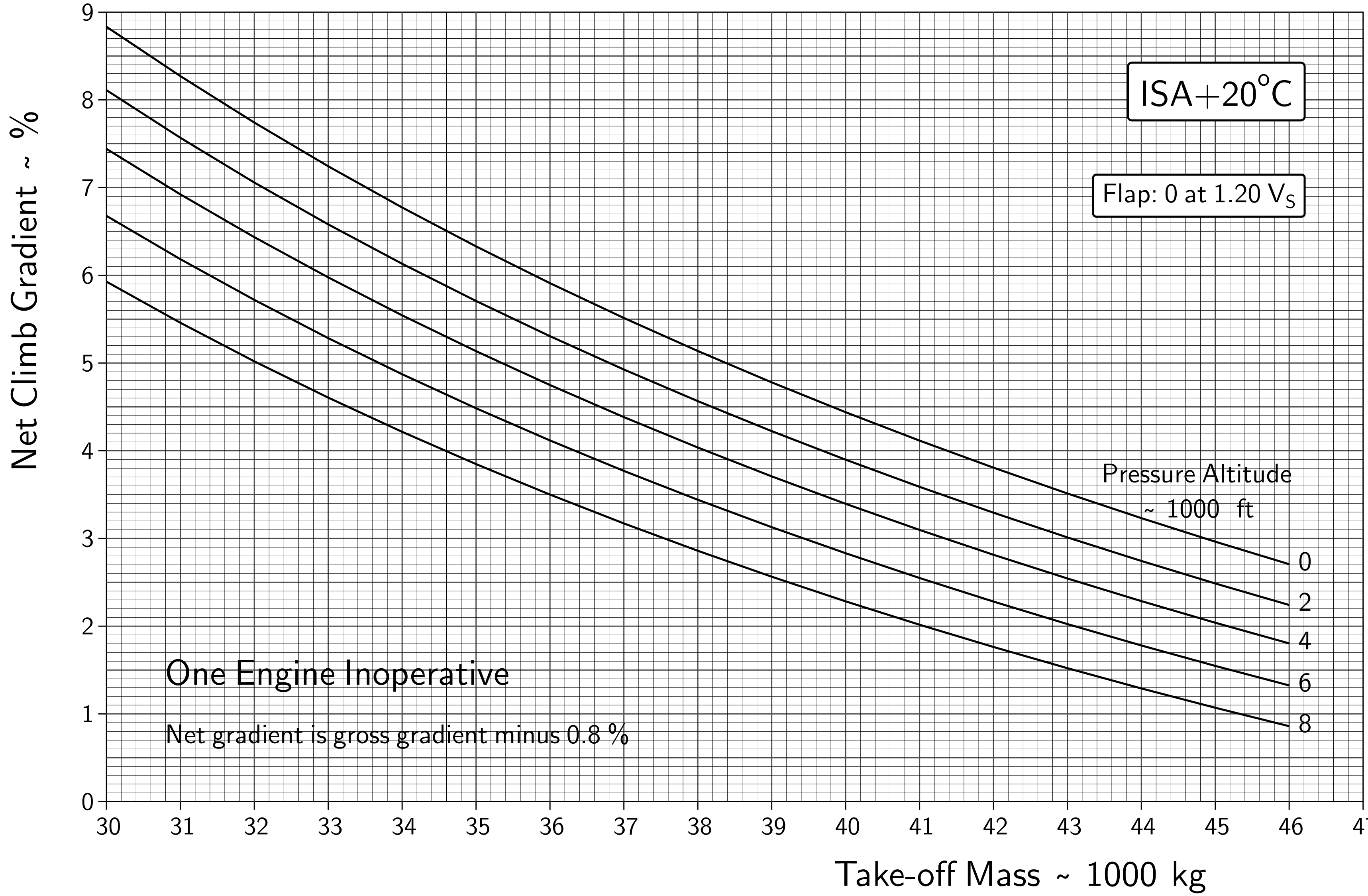

Figure 3.24: Net climb gradient with flap 0 and 1.20 V_S at ISA + 20°C.

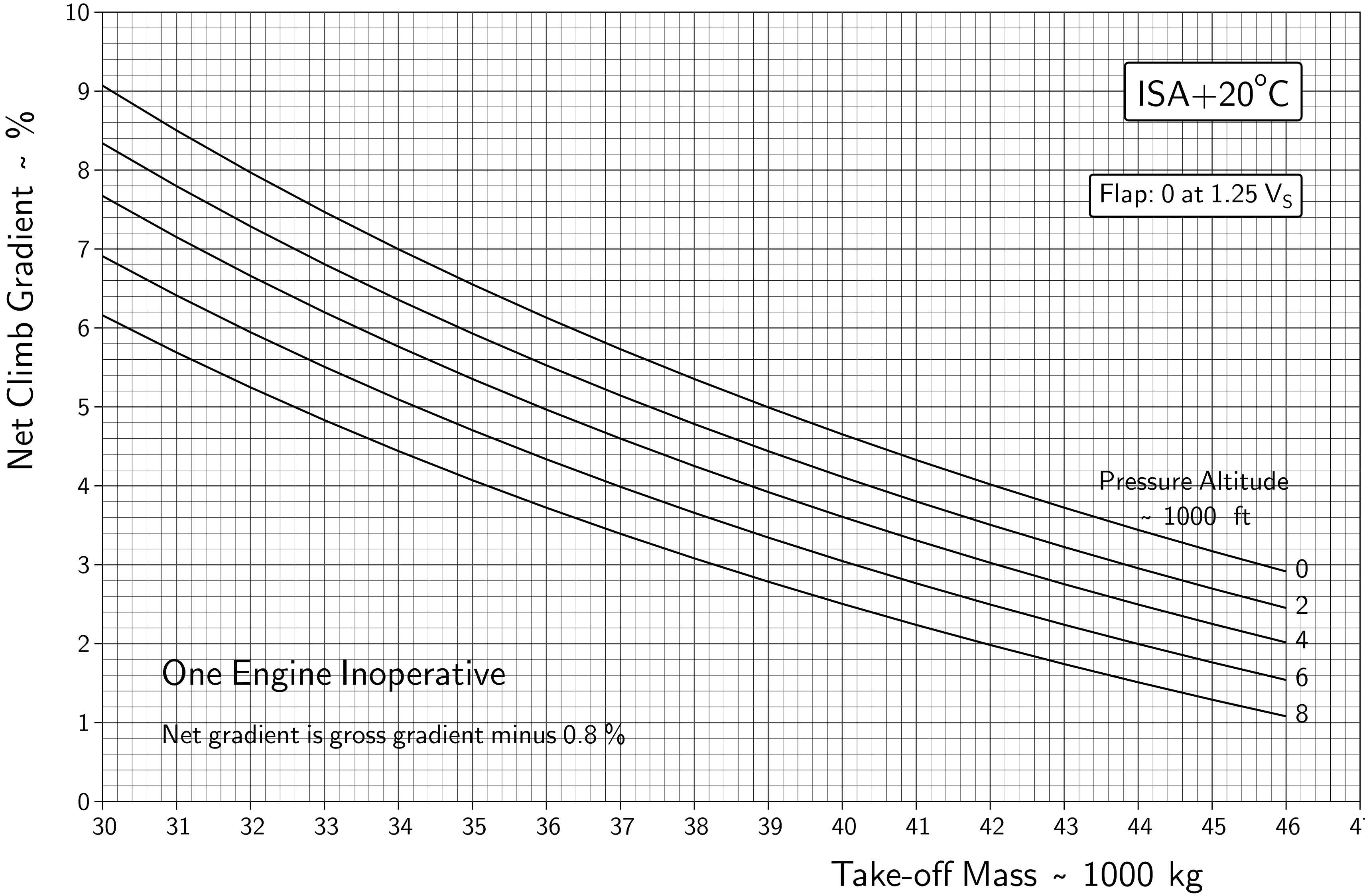

Figure 3.25: Net climb gradient with flap 0 and 1.25 V_S at ISA + 20°C.

Chapter 4

Landing

Introduction

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Assumptions

Joint Aviation Requirements 25 (Transport Category).
Landing field length factored by 1.667.
Smooth hard-surfaced runway, no slope, no wind.
Anti-icing off.

Figures

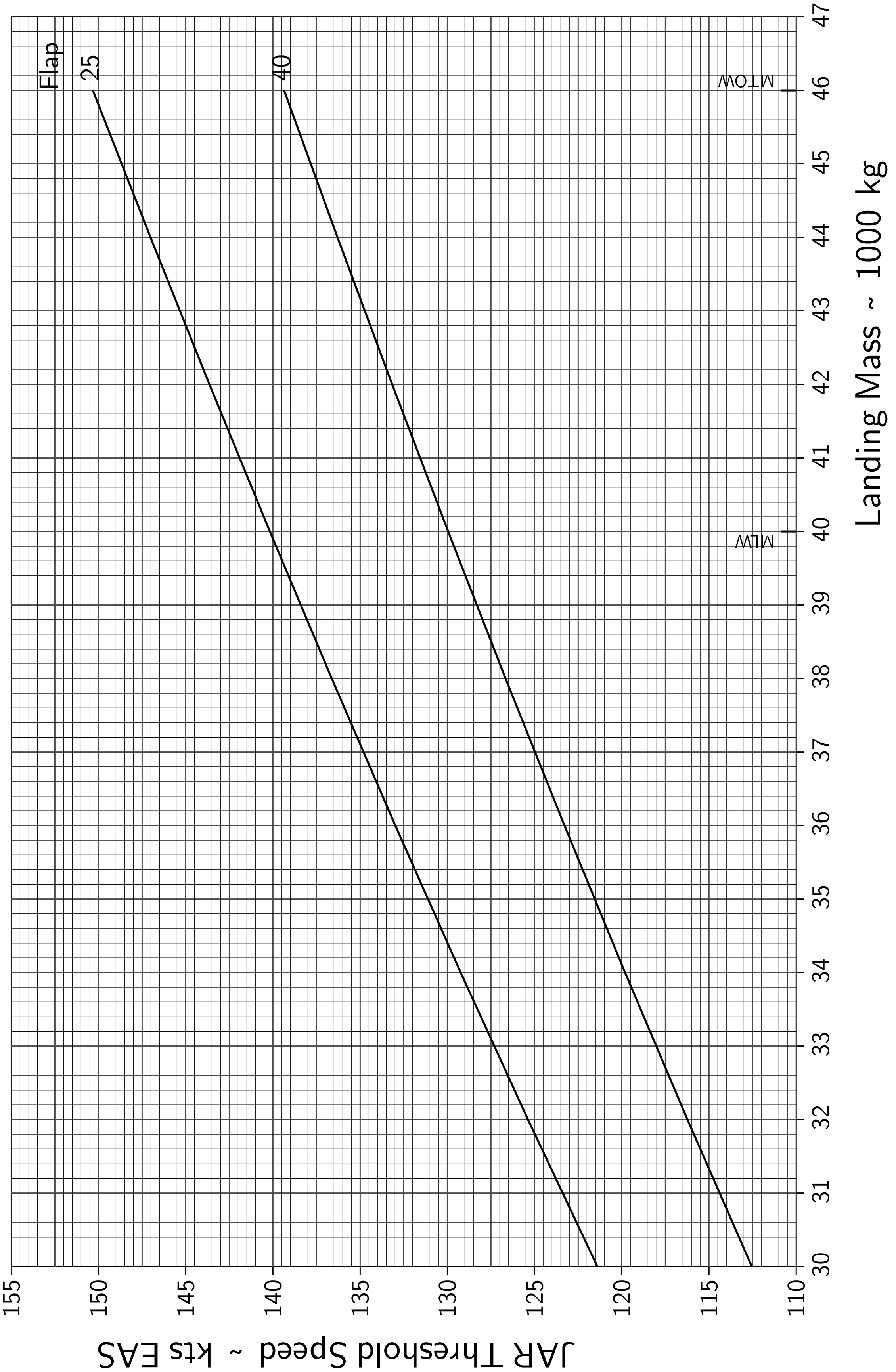

Figure 4.1: Threshold speed.

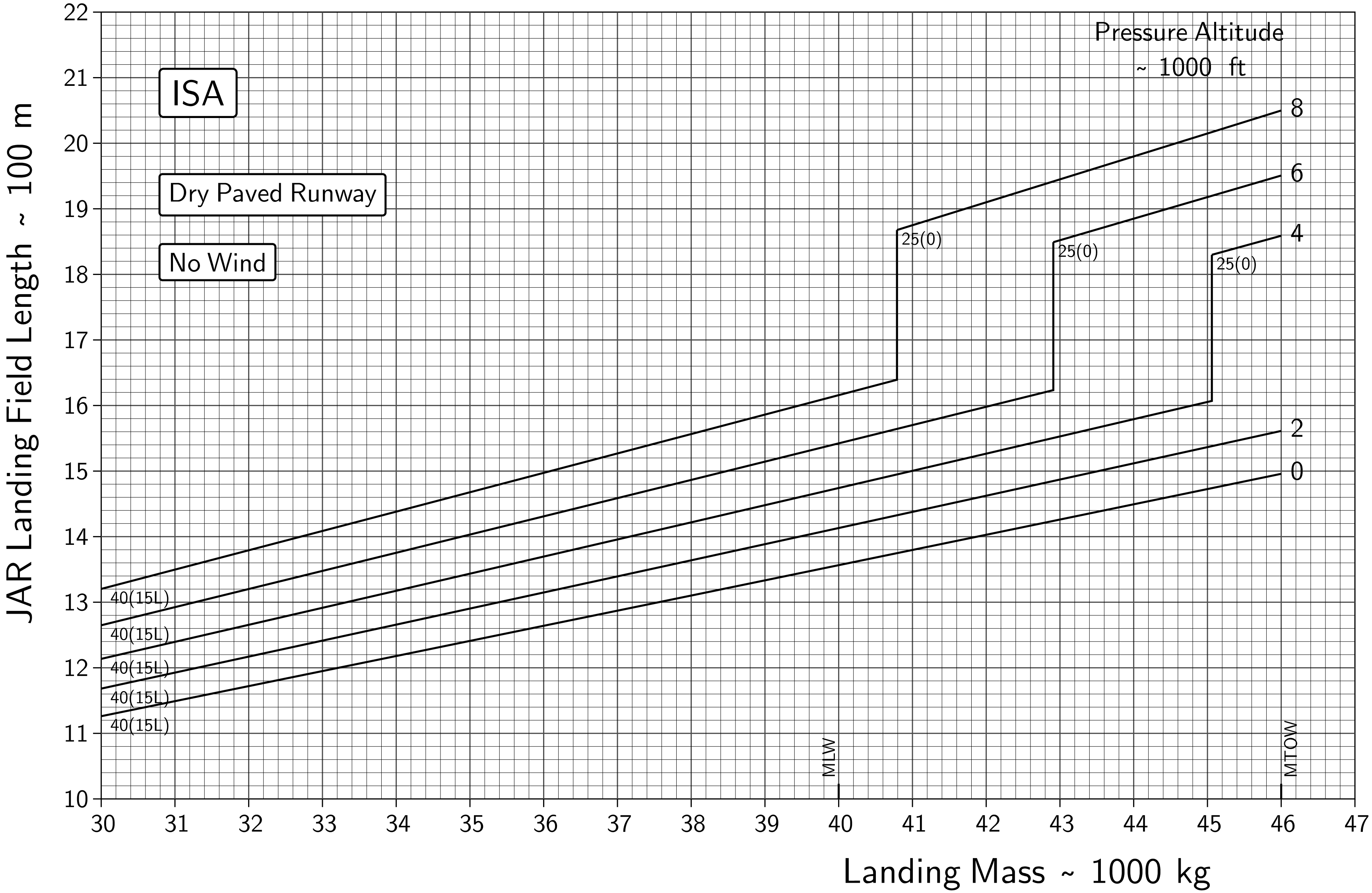

Figure 4.2: Landing field length, dry runway, at ISA.

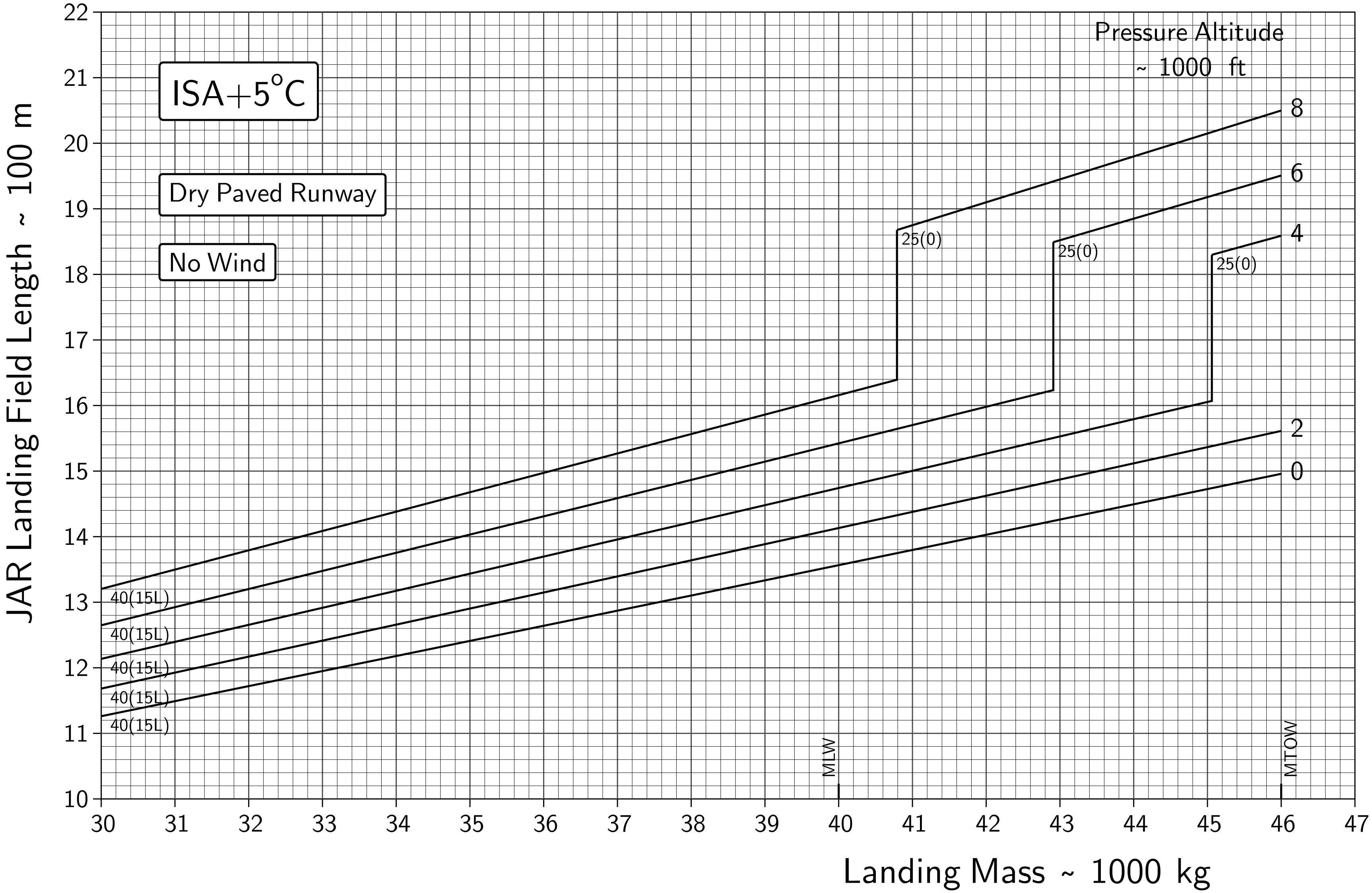

Figure 4.3: Landing field length, dry runway, at ISA + 5°C.

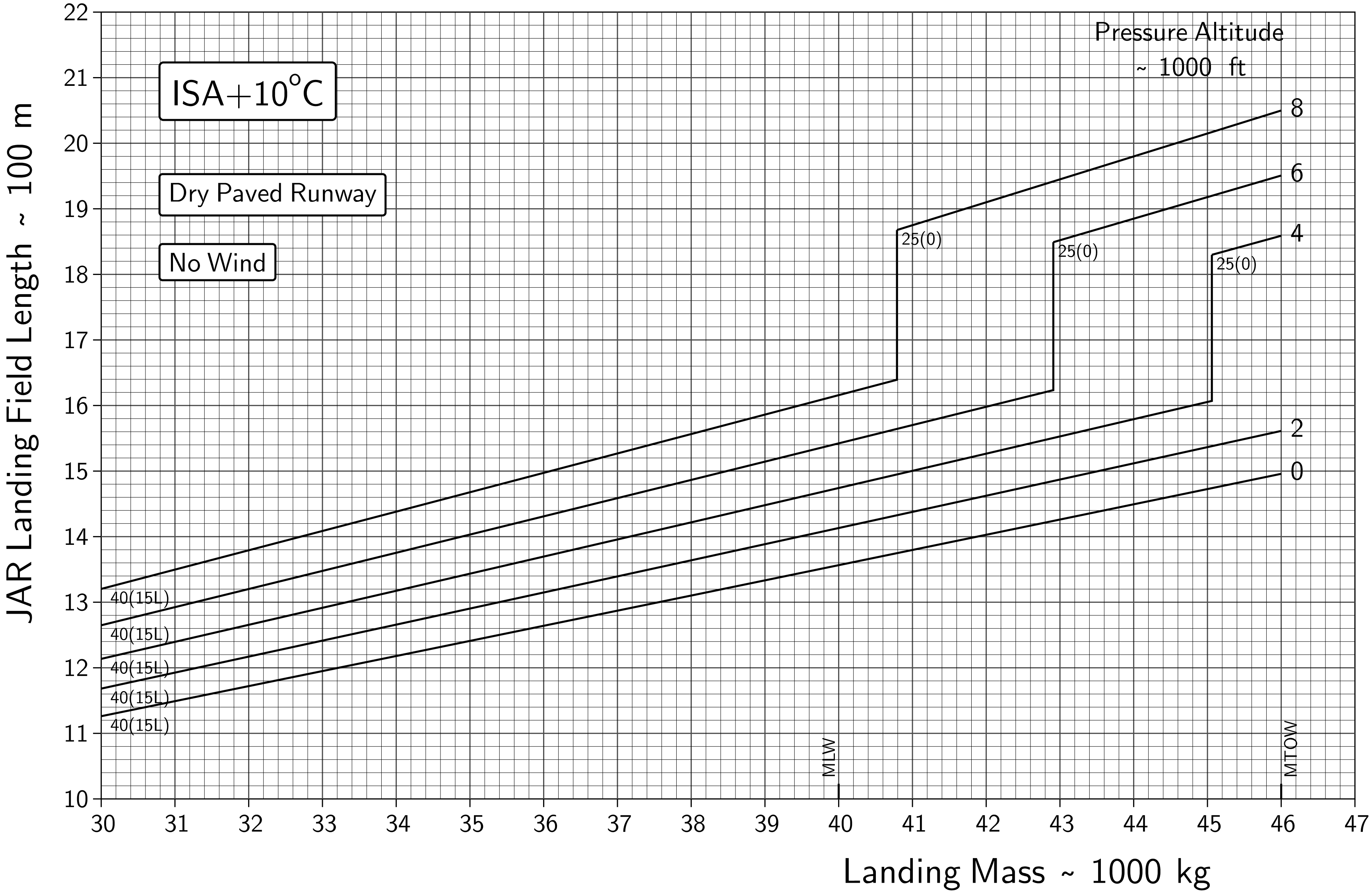

Figure 4.4: Landing field length, dry runway, at ISA + 10°C.

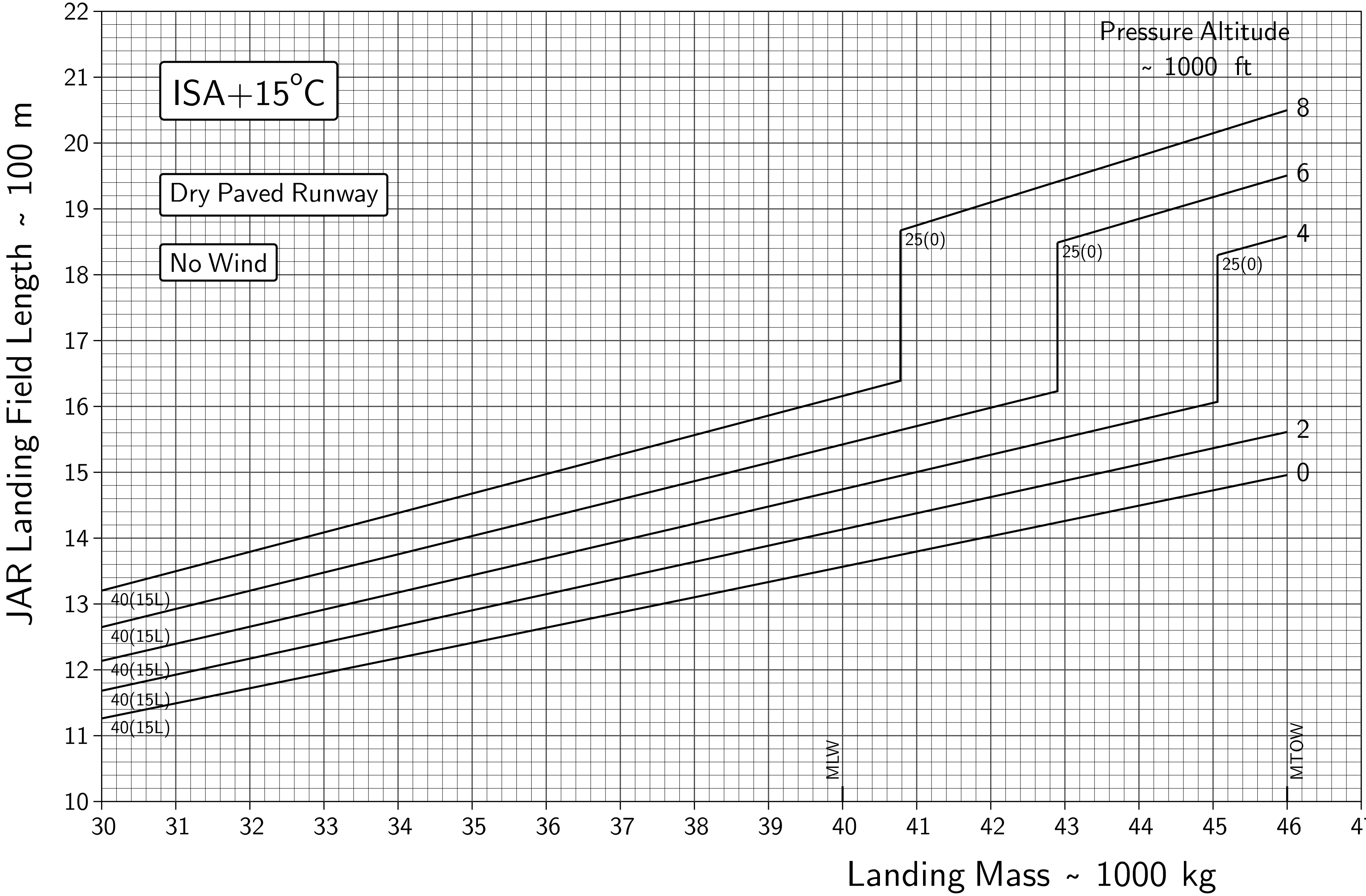

Figure 4.5: Landing field length, dry runway, at ISA + 15°C.

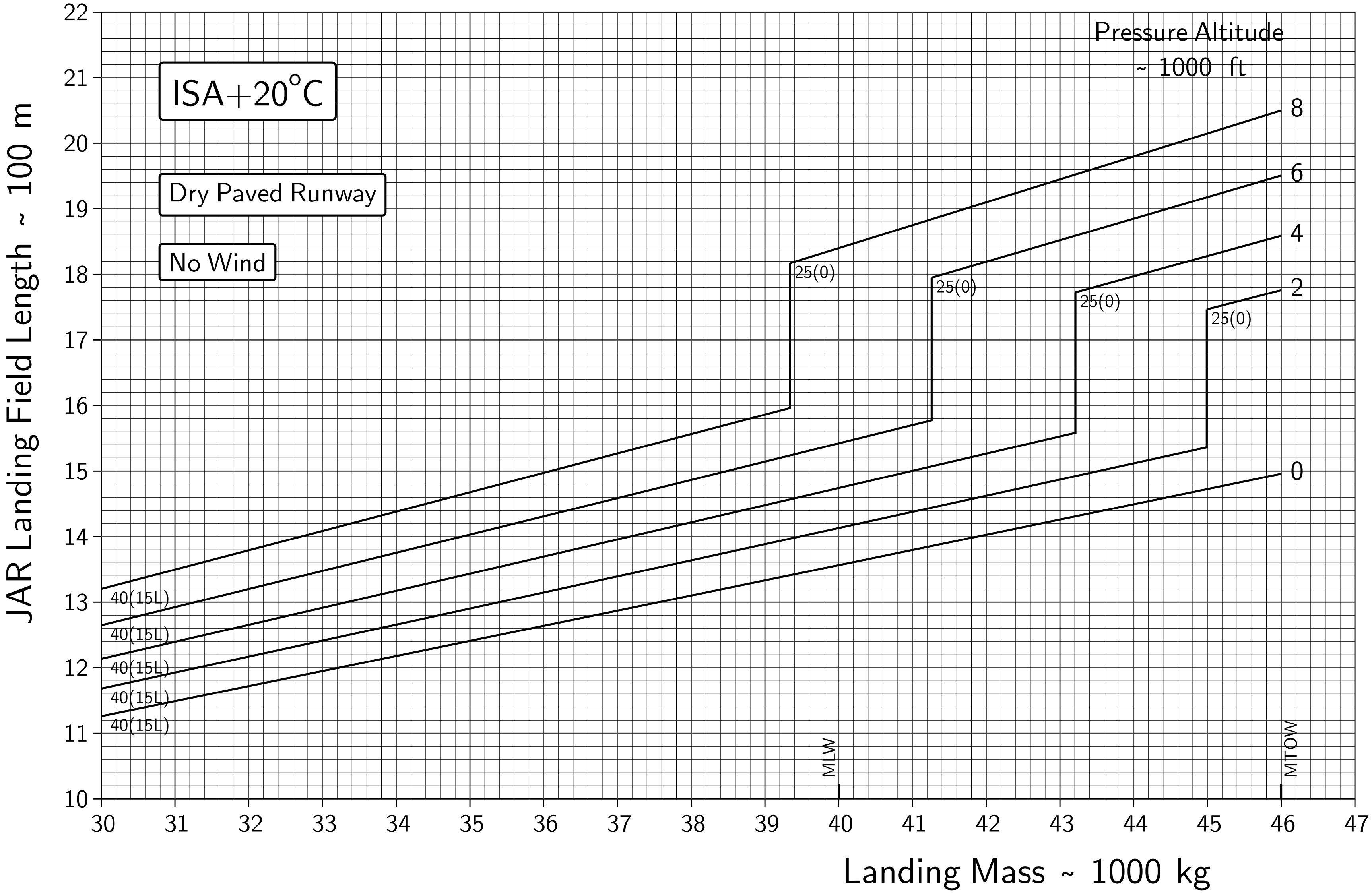

Figure 4.6: Landing field length, dry runway, at ISA + 20°C.

Chapter 5

Climb

Assumptions

Engines at maximum climb rating.
Operational speed restriction of 250 kts **CAS** below 10 000 ft.
No wind.

Figures

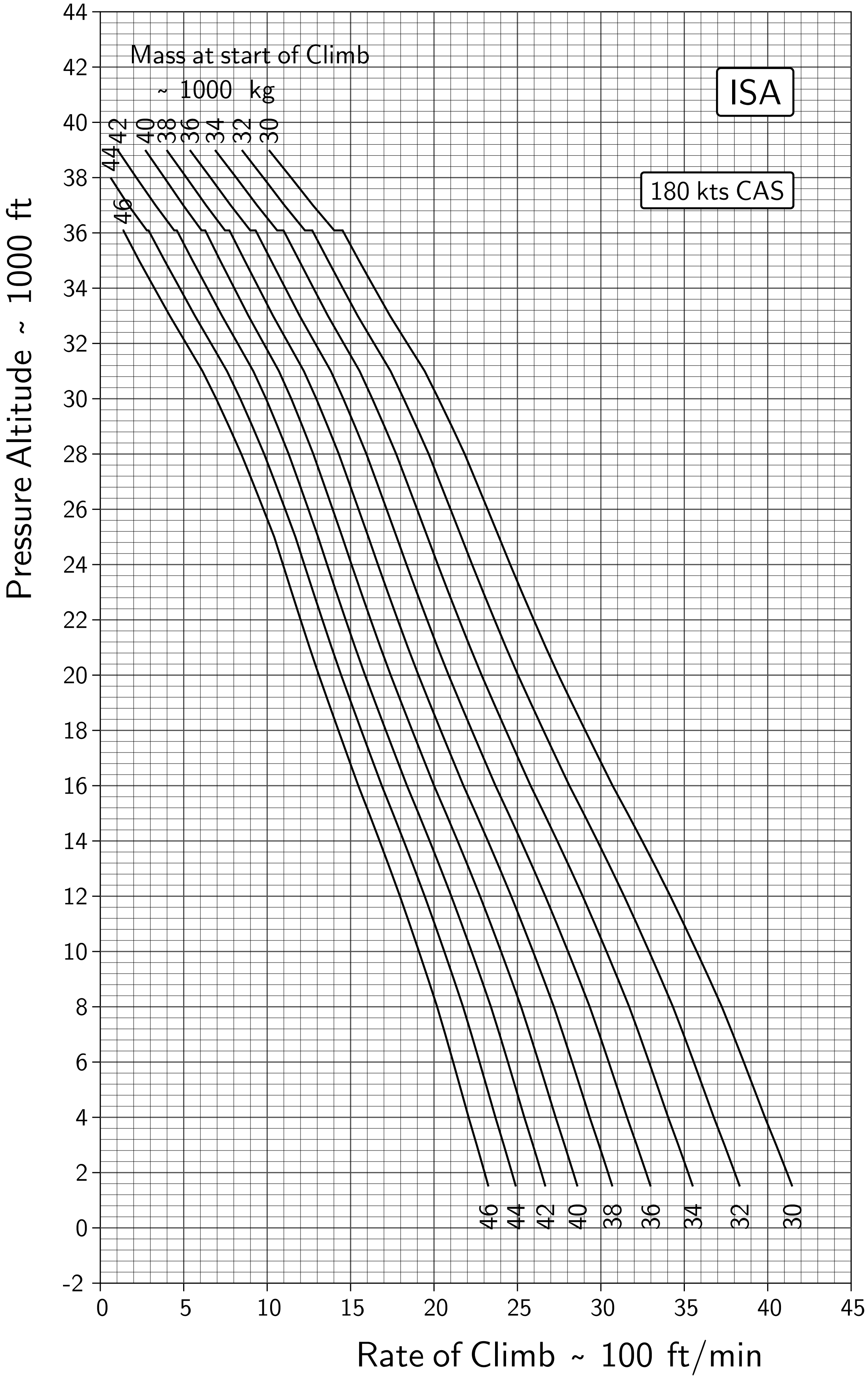

Figure 5.1: Rate of climb at 180 kts CAS / Mach 0.77 at ISA.

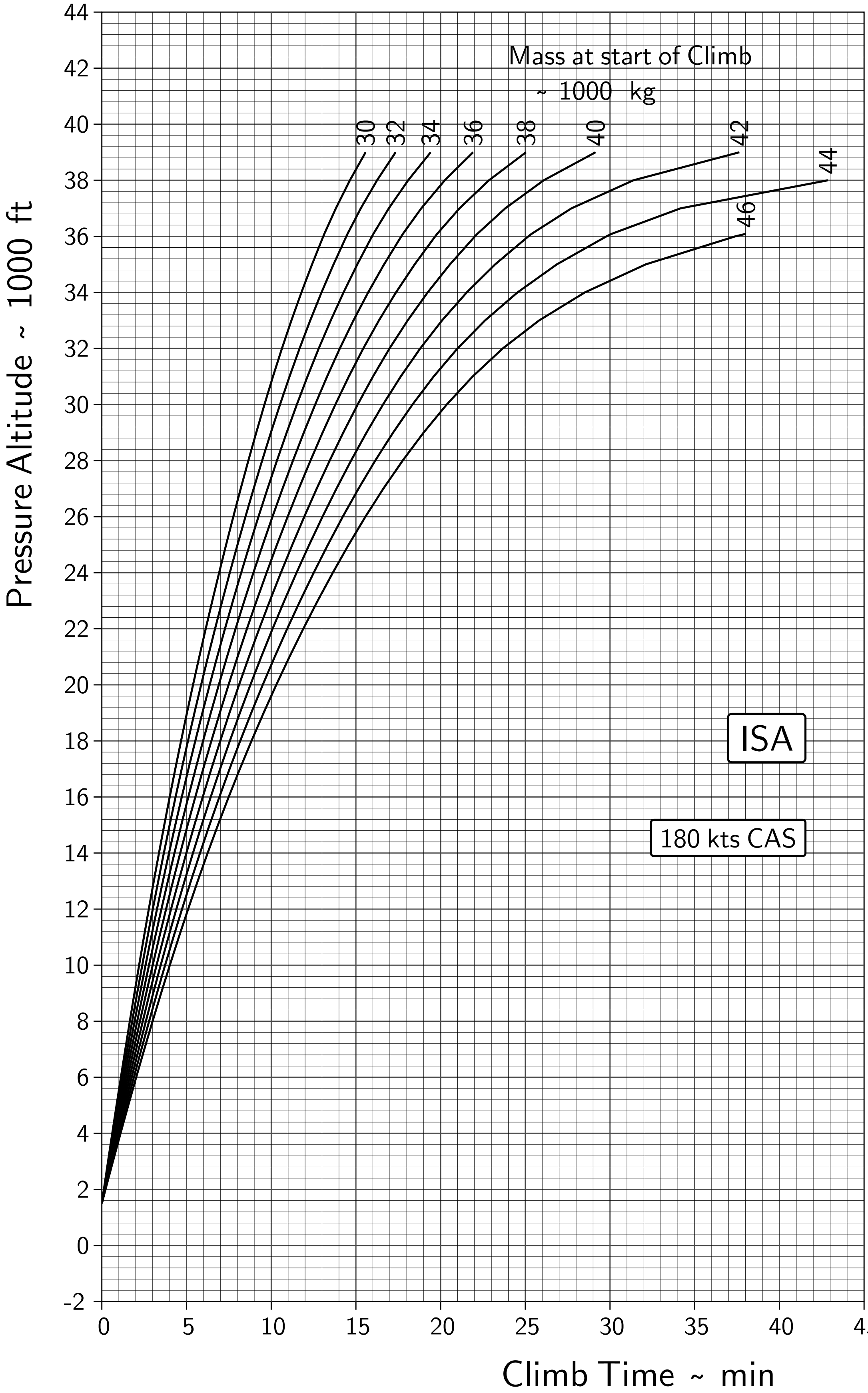

Figure 5.2: Climb time at 180 kts CAS / Mach 0.77 at ISA.

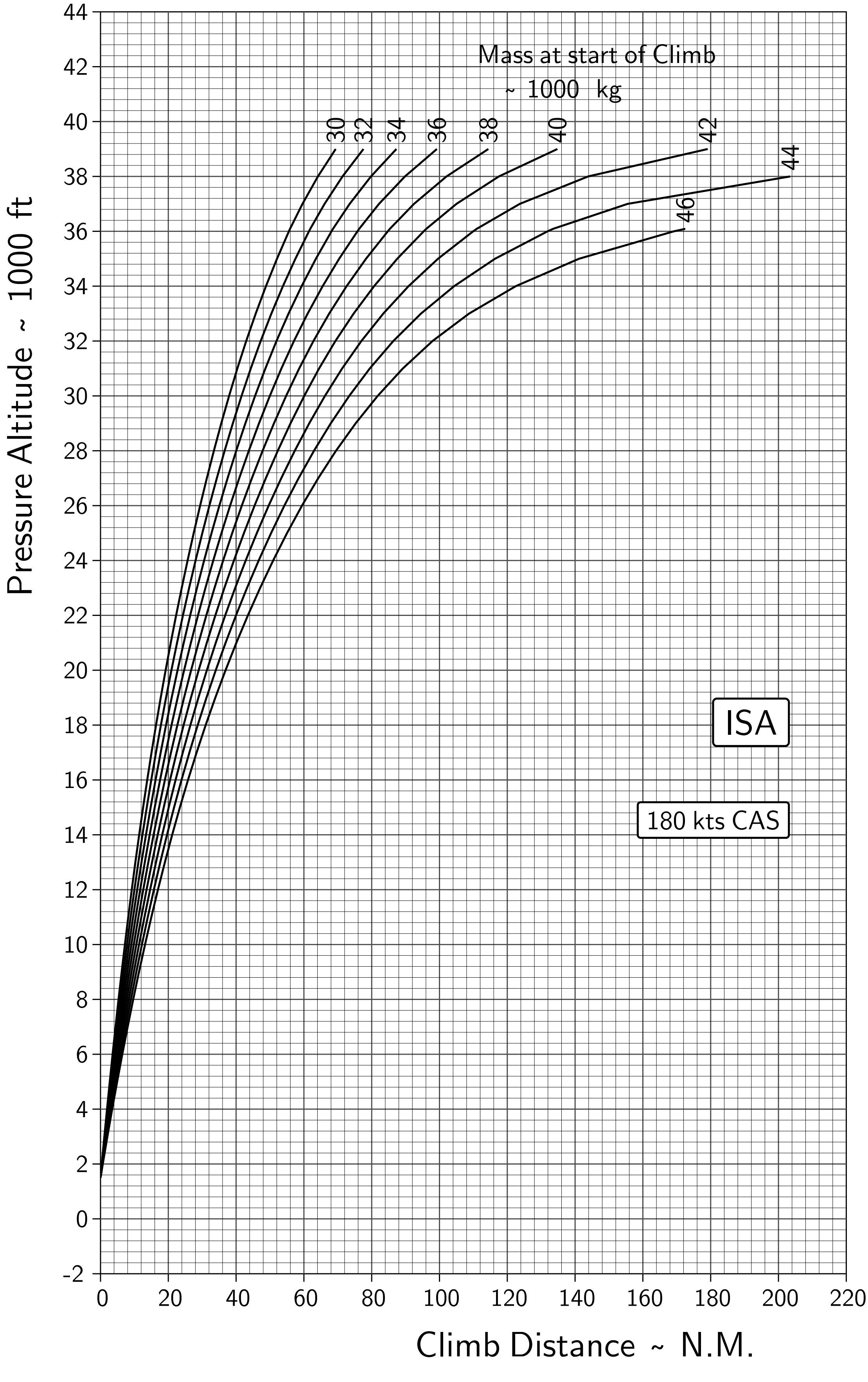

Figure 5.3: Climb distance at 180 kts CAS / Mach 0.77 at ISA.

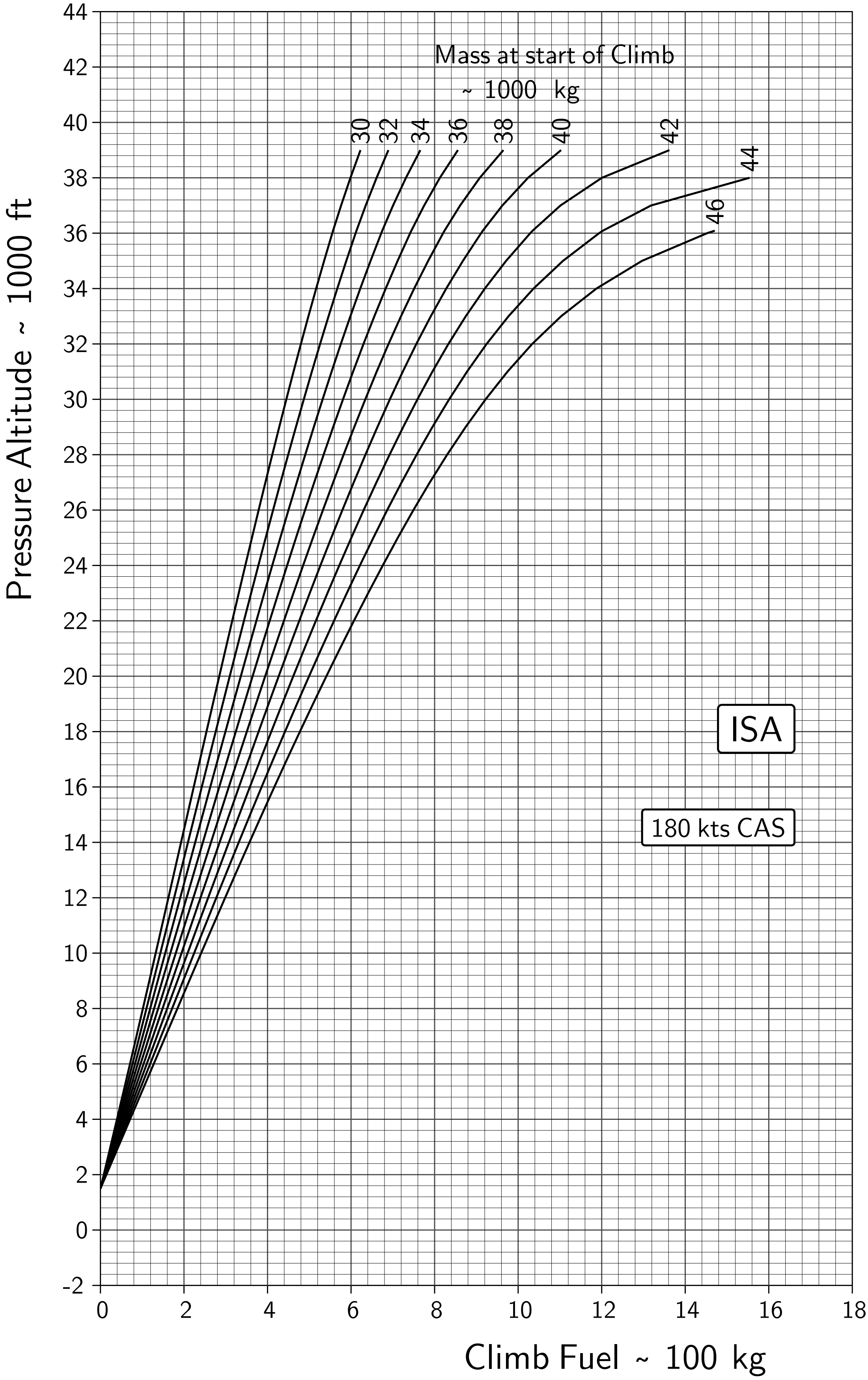

Figure 5.4: Climb fuel at 180 kts CAS / Mach 0.77 at ISA.

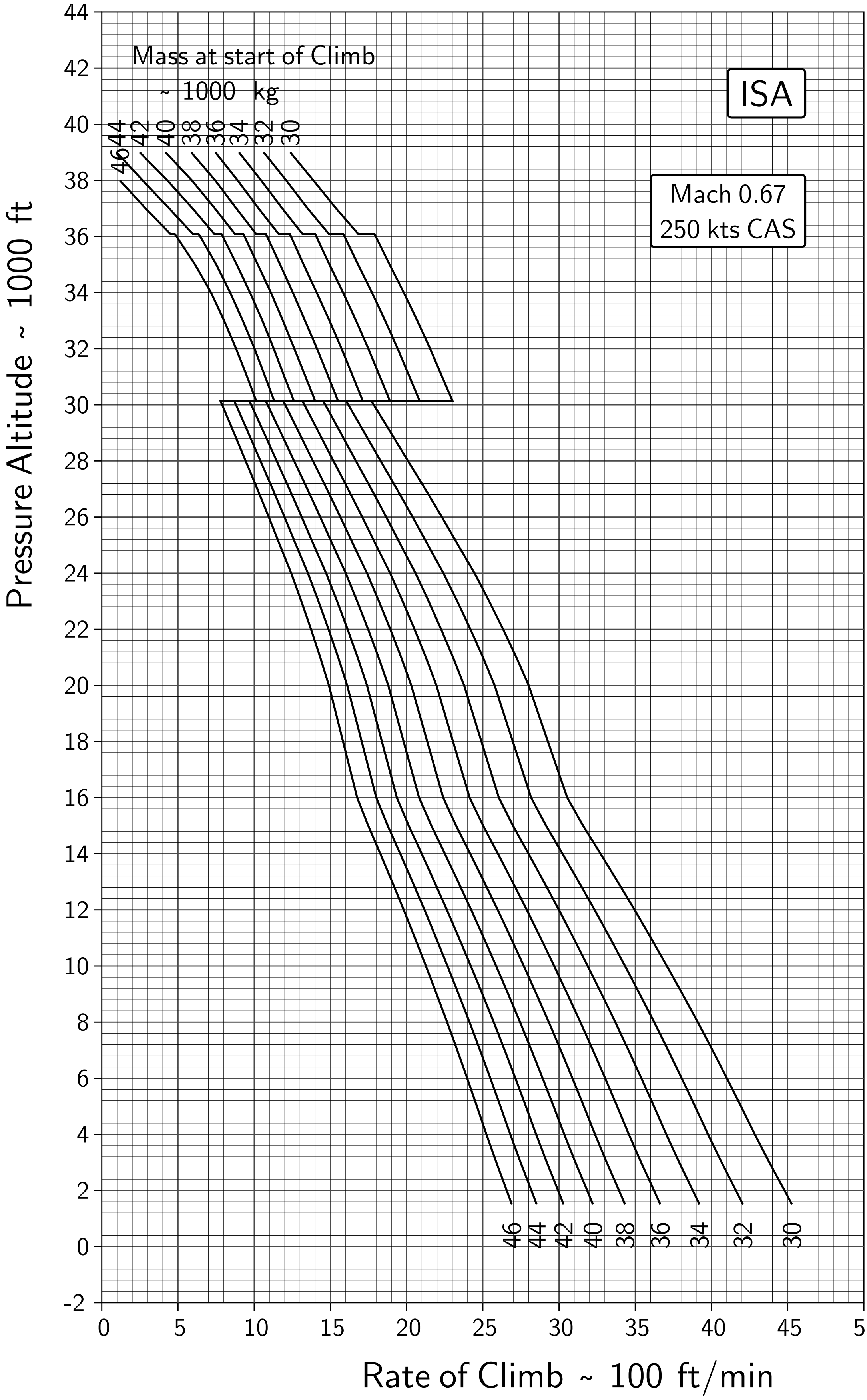

Figure 5.5: Rate of climb at 250 kts CAS / Mach 0.67 at ISA.

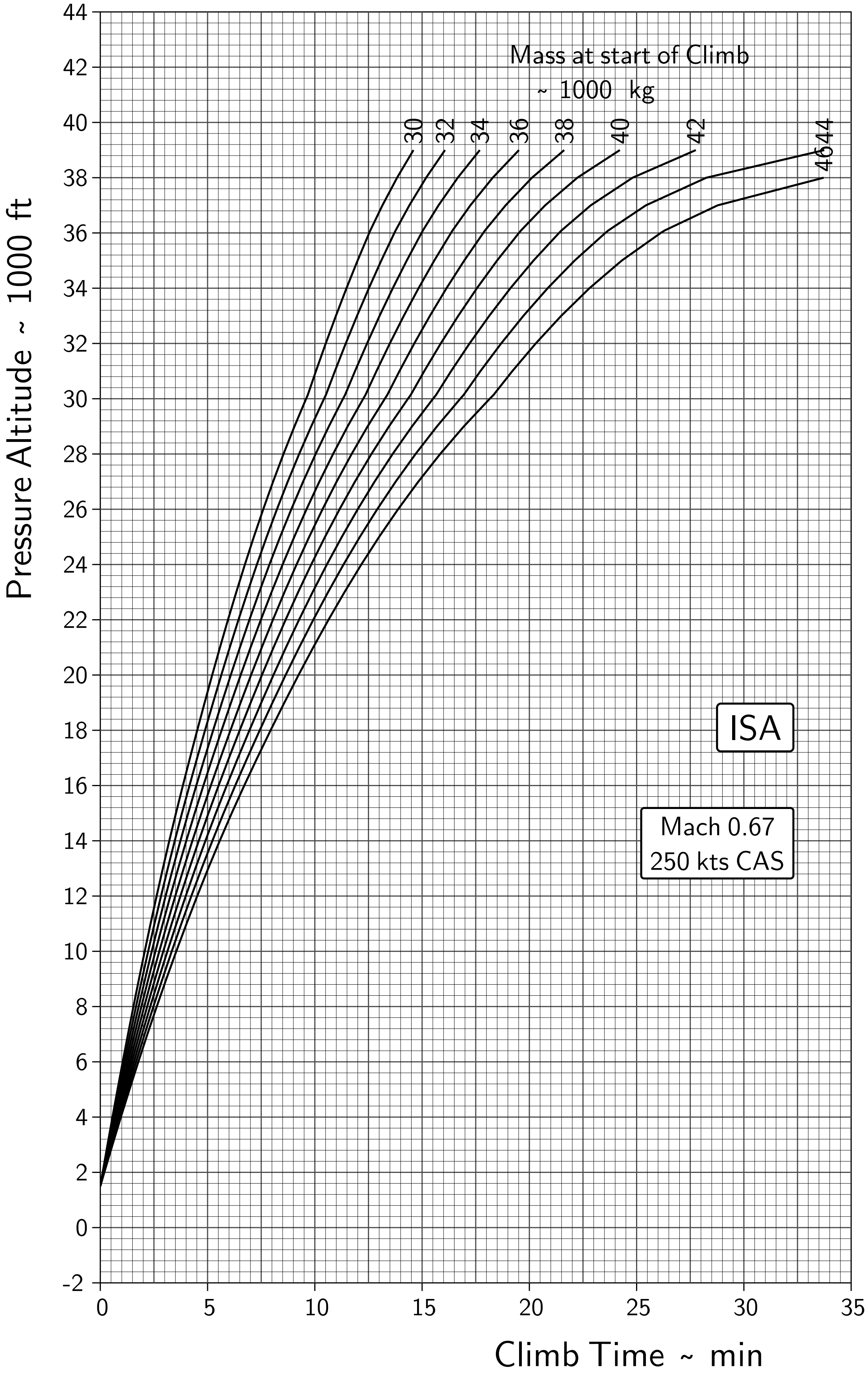

Figure 5.6: Climb time at 250 kts CAS / Mach 0.67 at ISA.

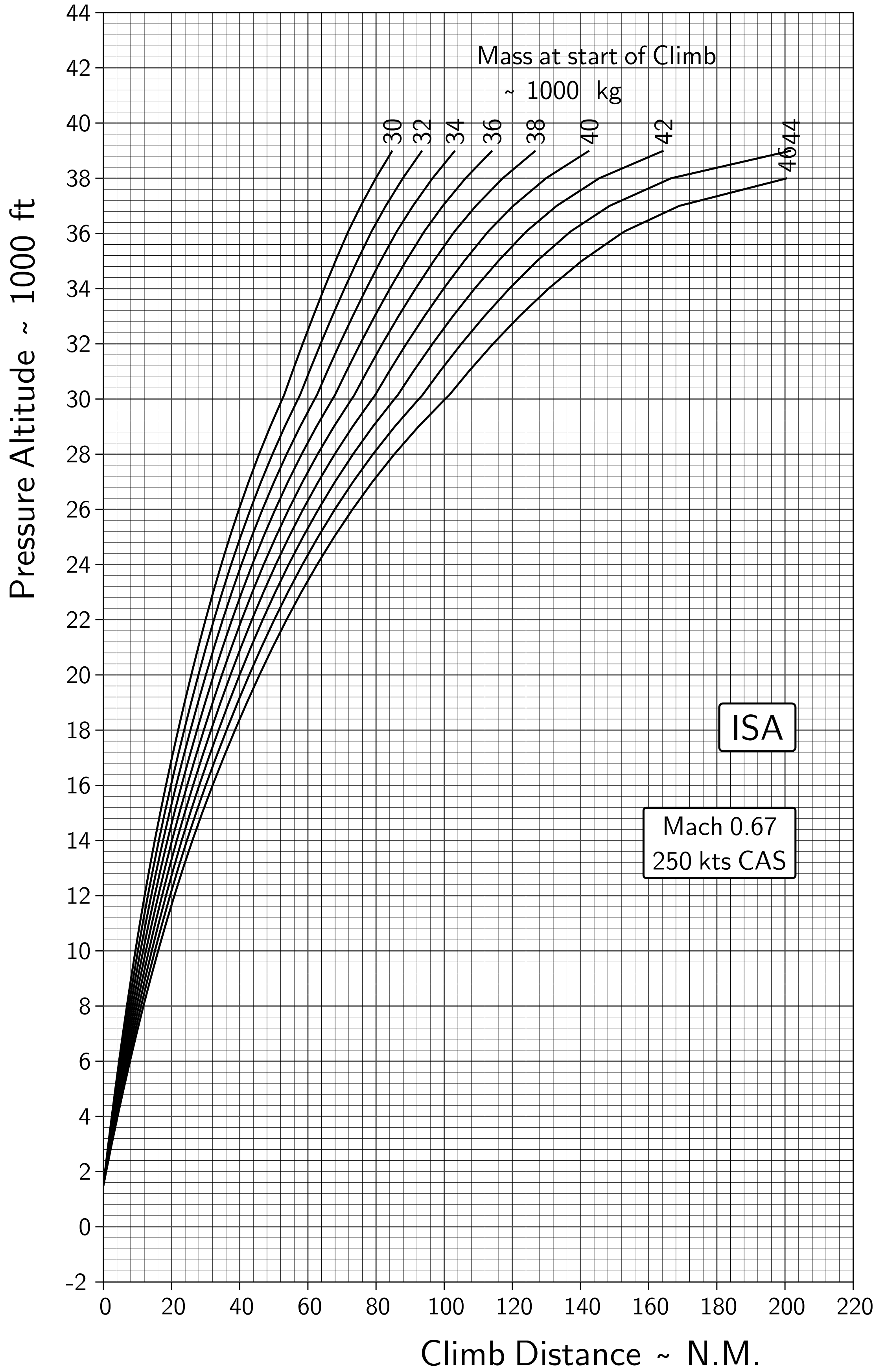

Figure 5.7: Climb distance at 250 kts CAS / Mach 0.67 at ISA.

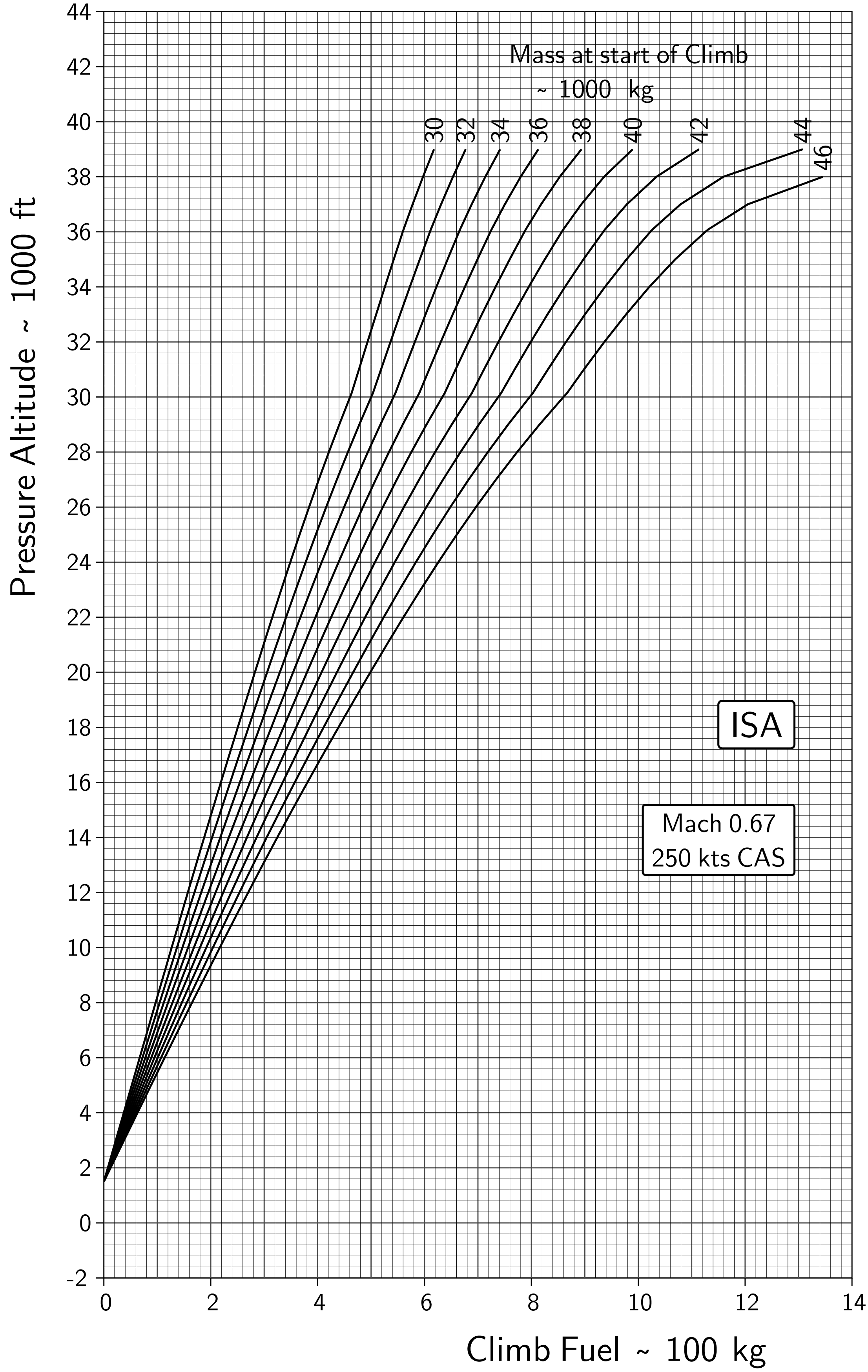

Figure 5.8: Climb fuel at 250 kts CAS / Mach 0.67 at ISA.

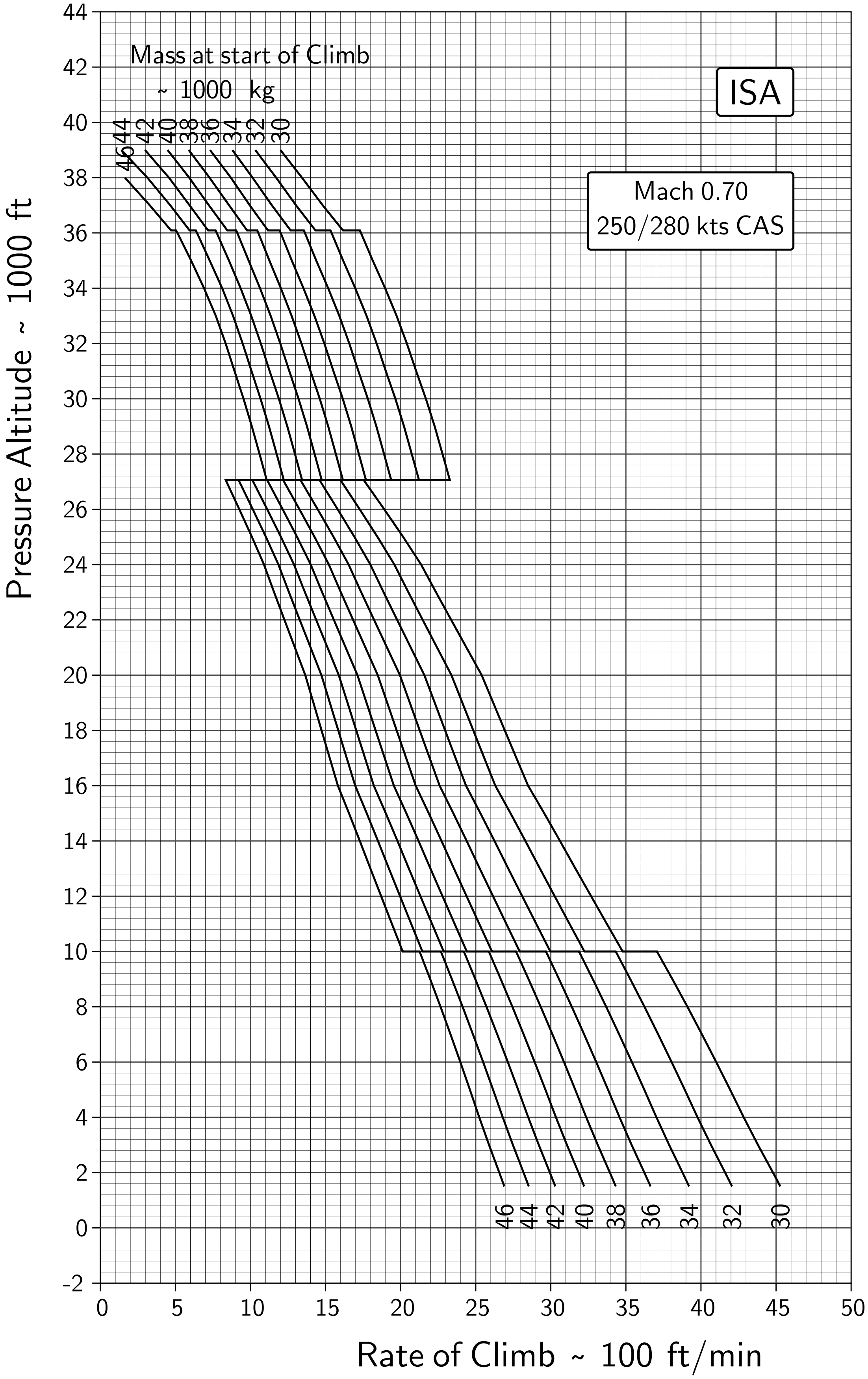

Figure 5.9: Rate of climb at 250/280 kts CAS / Mach 0.70 at ISA.

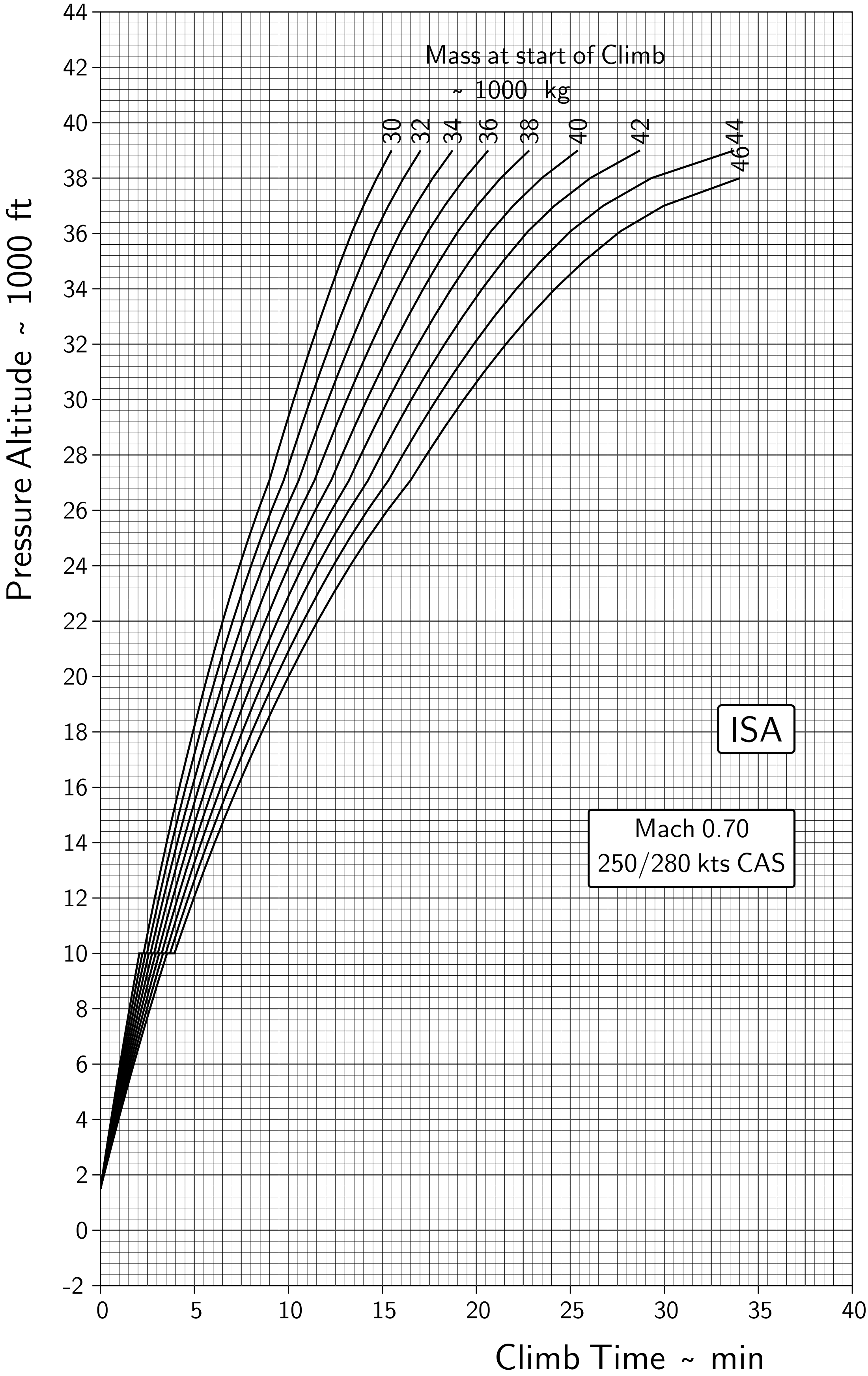

Figure 5.10: Climb time at 250/280 kts CAS / Mach 0.70 at ISA.

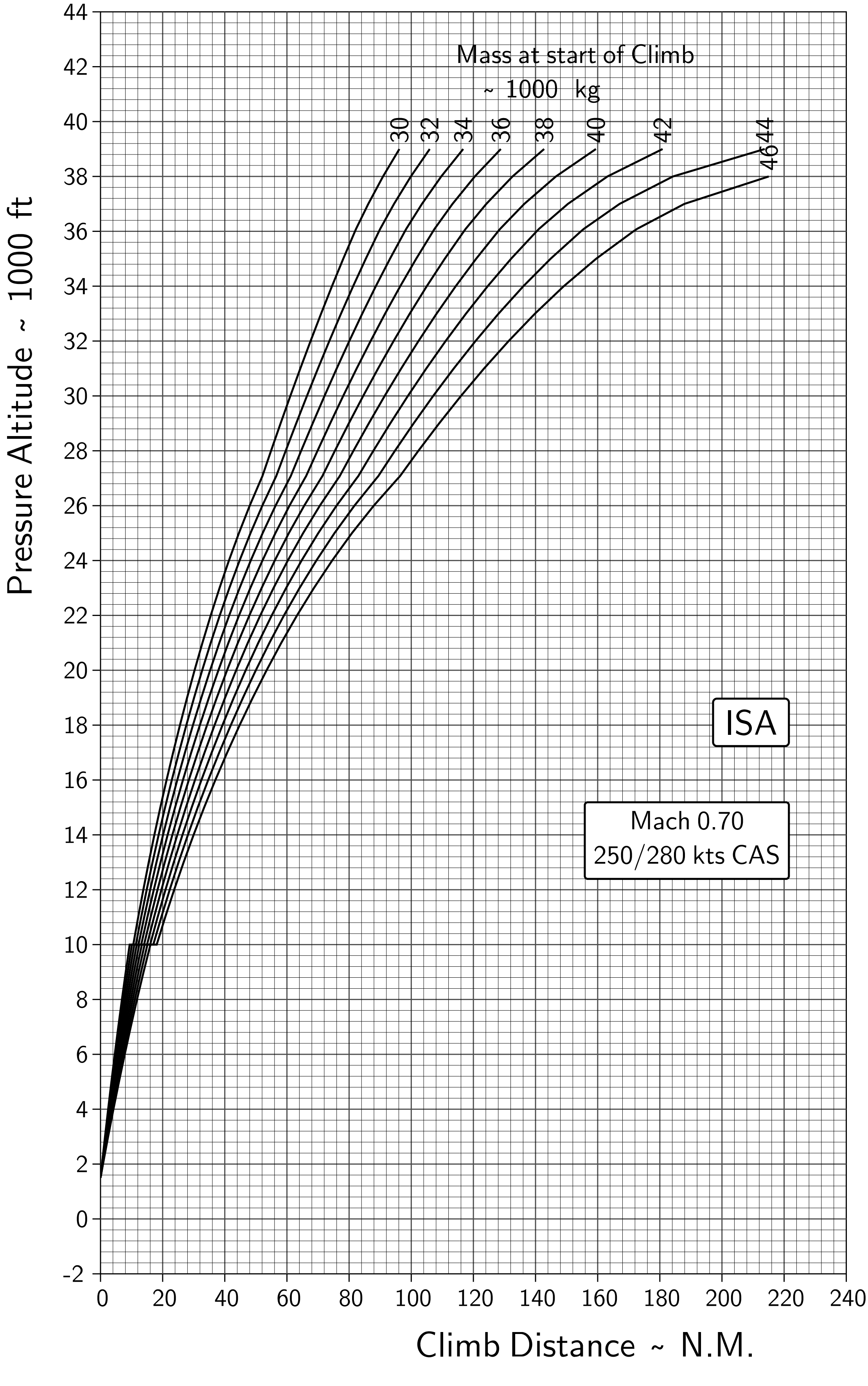

Figure 5.11: Climb distance at 250/280 kts CAS / Mach 0.70 at ISA.

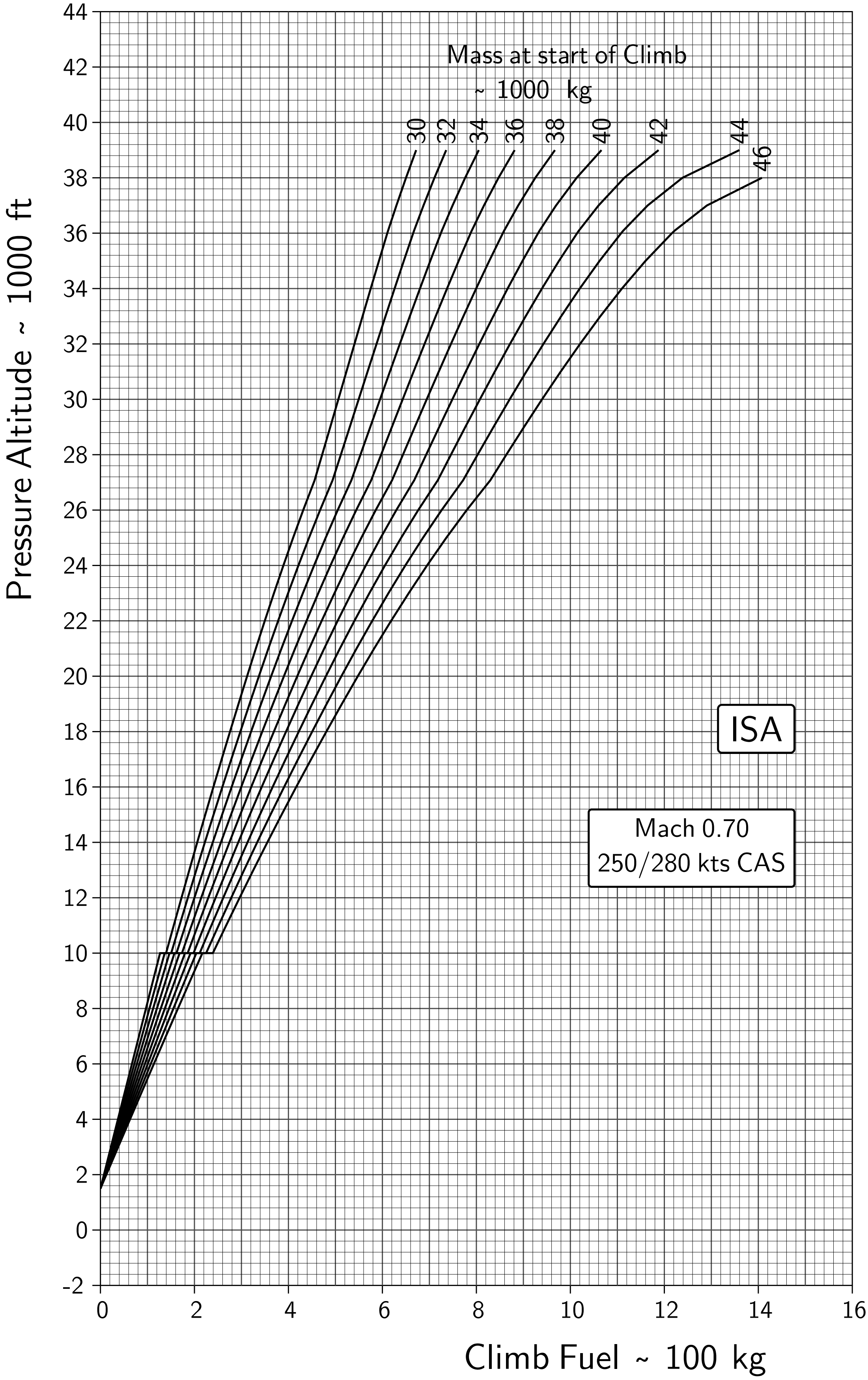

Figure 5.12: Climb fuel at 250/280 kts CAS / Mach 0.70 at ISA.

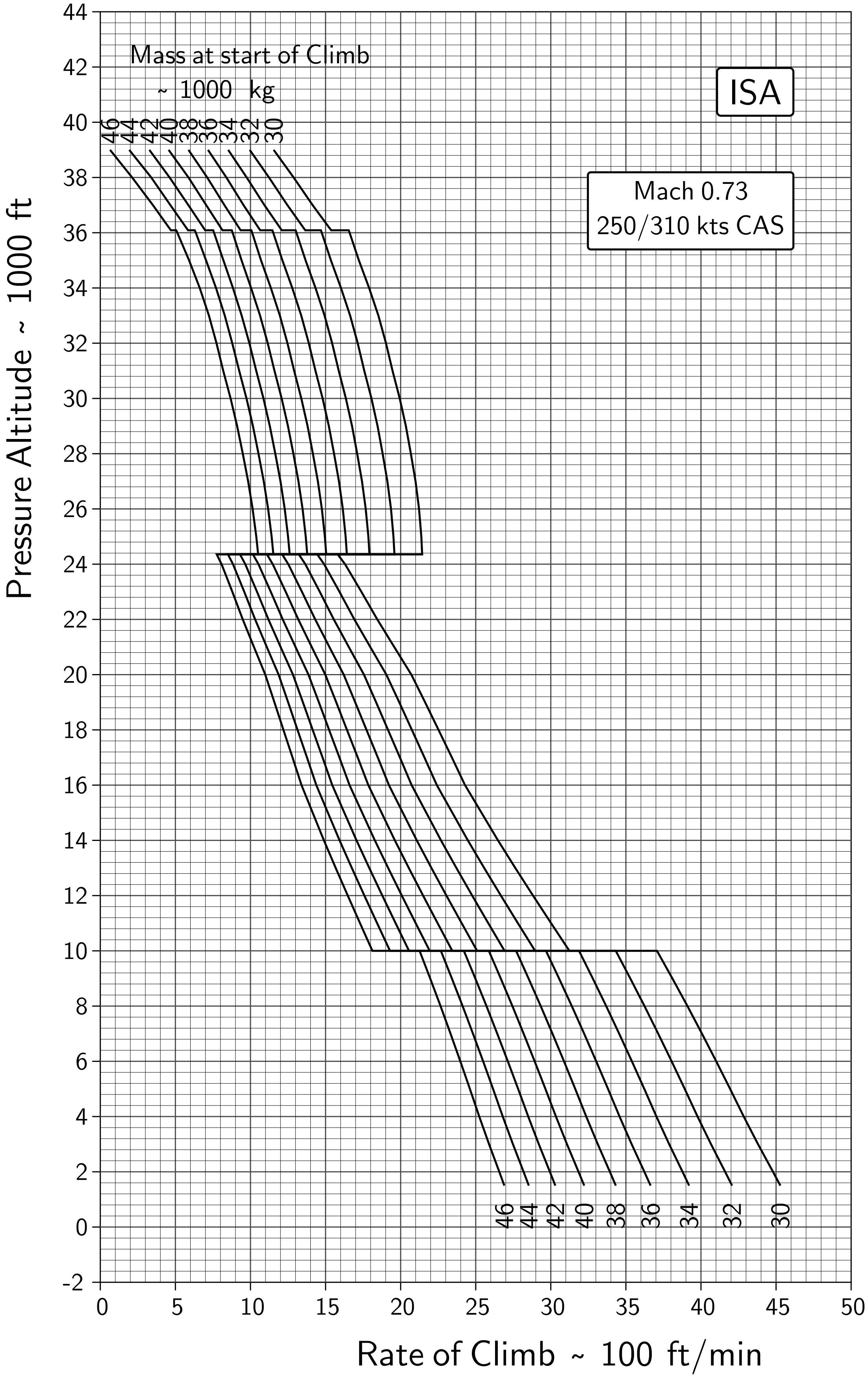

Figure 5.13: Rate of climb at 250/310 kts CAS / Mach 0.73 at ISA.

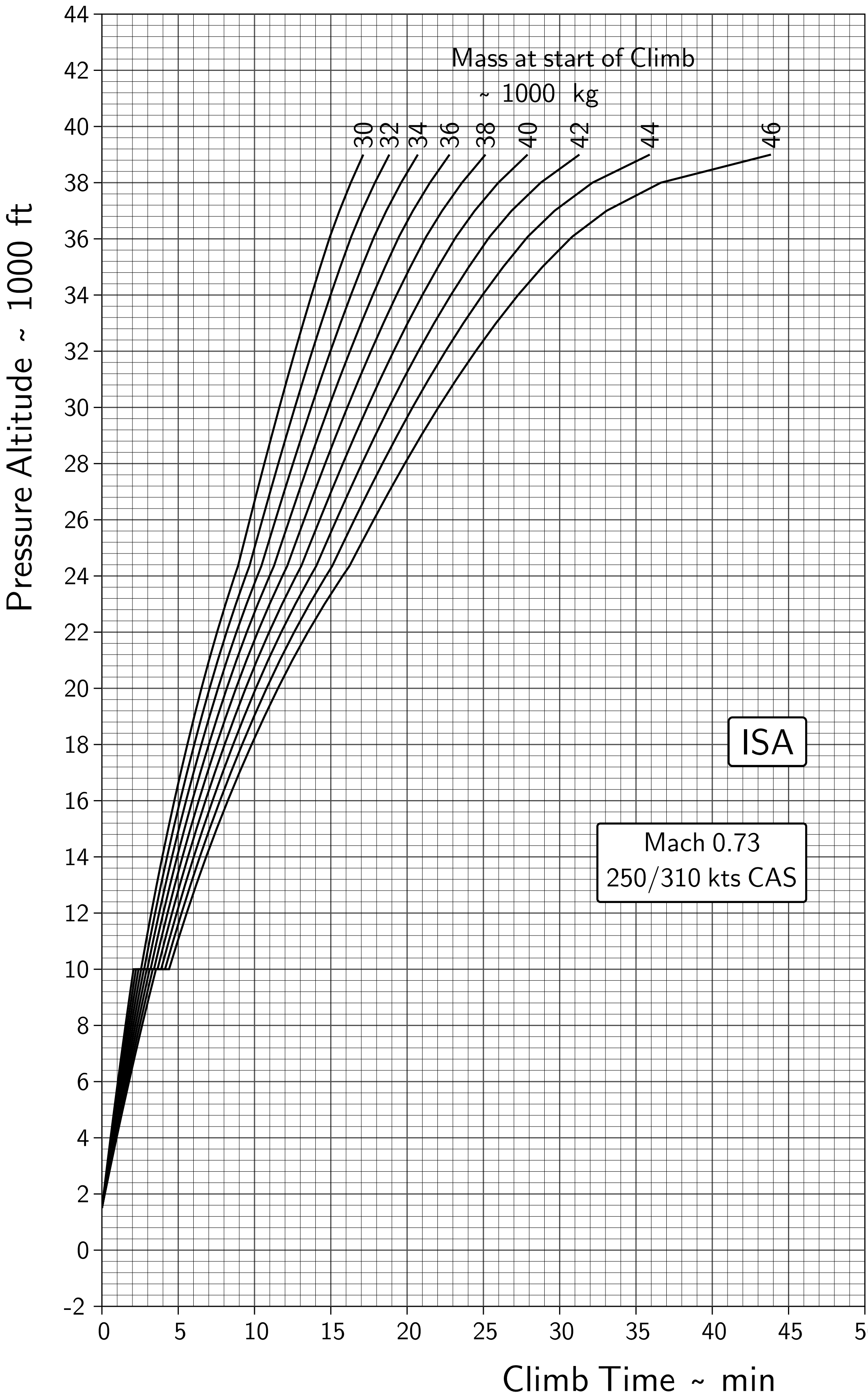

Figure 5.14: Climb time at 250/310 kts CAS / Mach 0.73 at ISA.

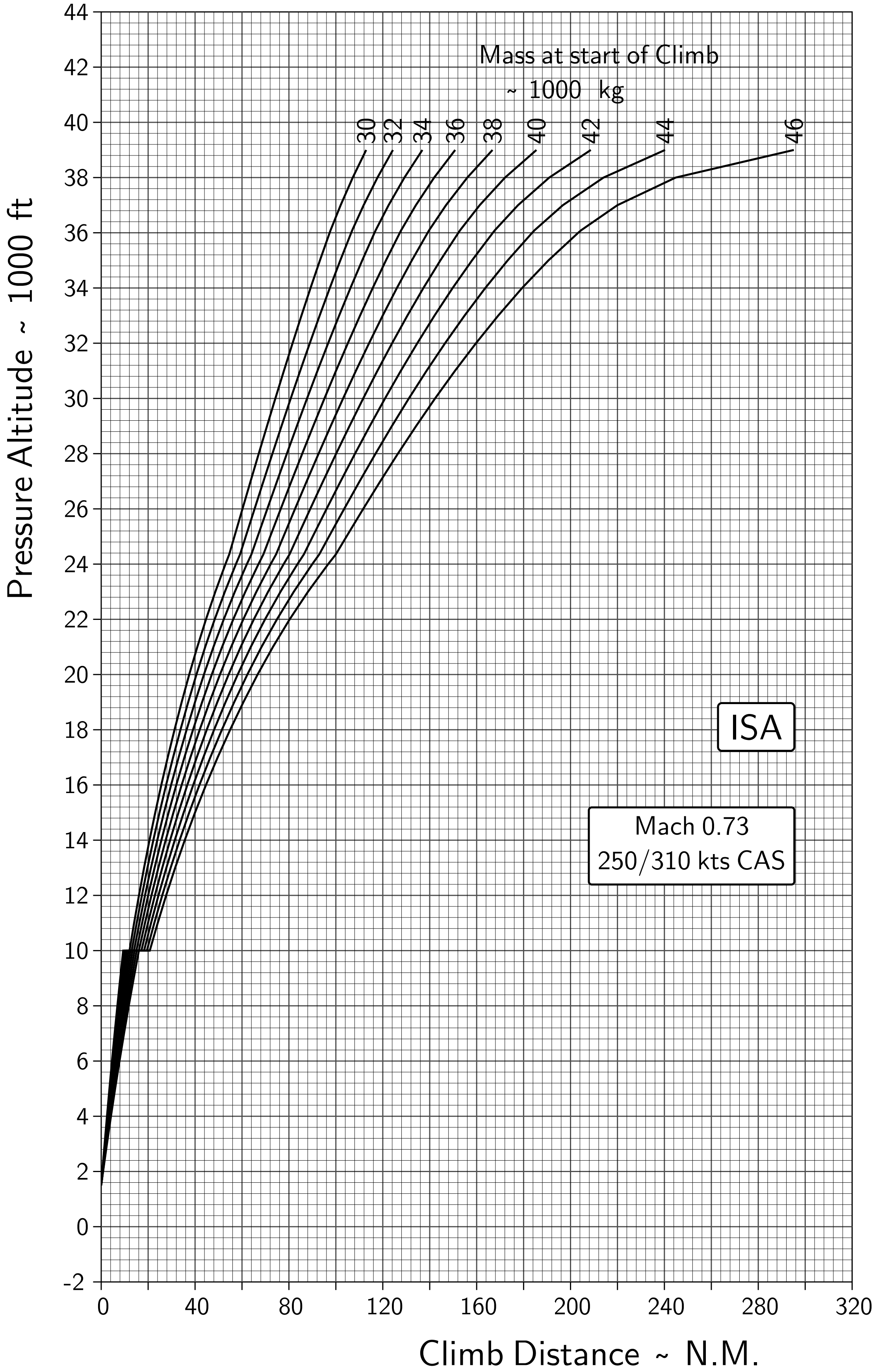

Figure 5.15: Climb distance at 250/310 kts CAS / Mach 0.73 at ISA.

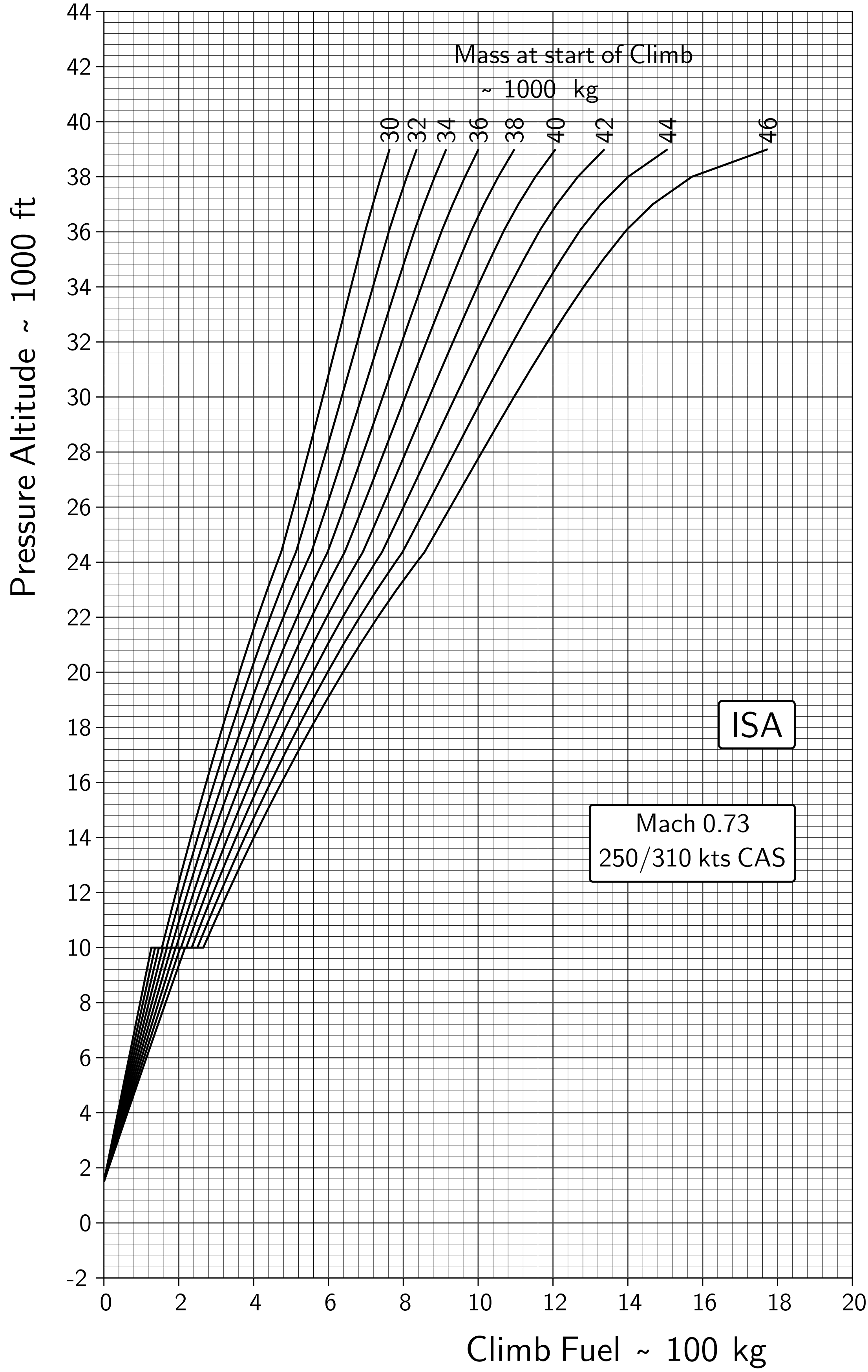

Figure 5.16: Climb fuel at 250/310 kts CAS / Mach 0.73 at ISA.

Chapter 6

Cruise

Assumptions

Specific range in still air.
Long-range is defined as 99 % of best specific range.
Maximum speed in level flight determined by maximum cruise thrust or V_{mo}/M_{mo}.

Figures

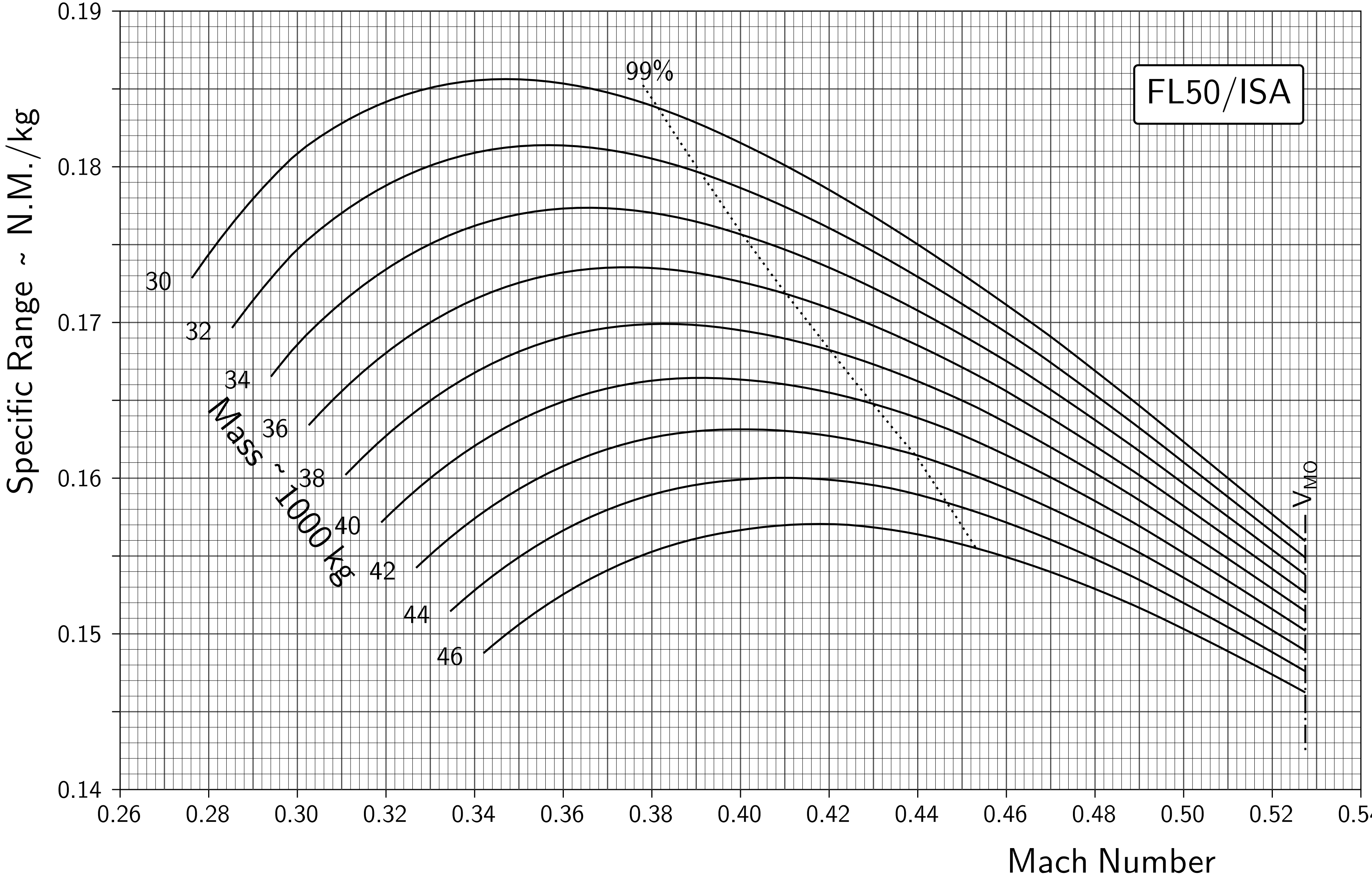

Figure 6.1: Specific range at FL50 / ISA.

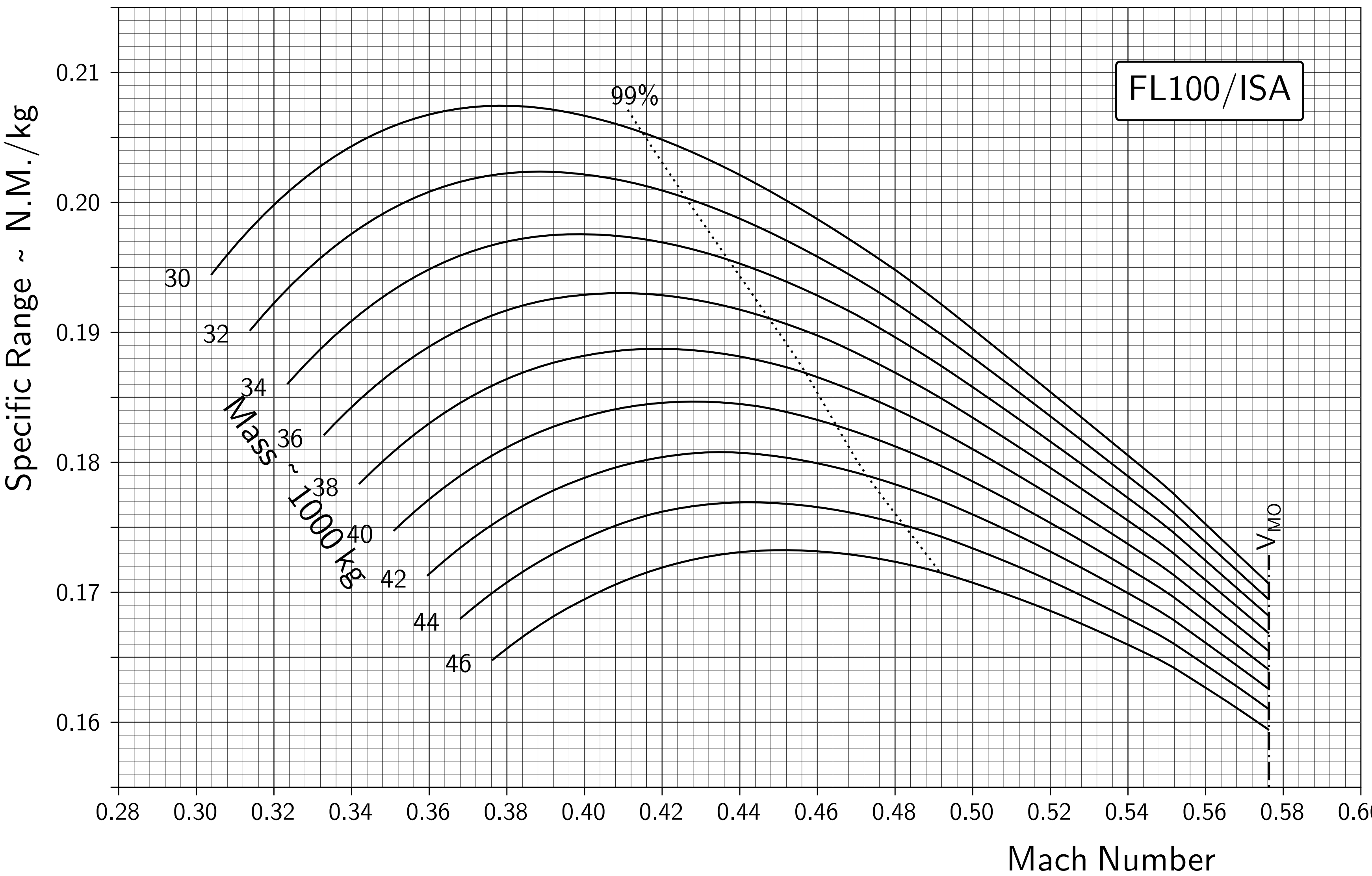

Figure 6.2: Specific range at FL100 / ISA.

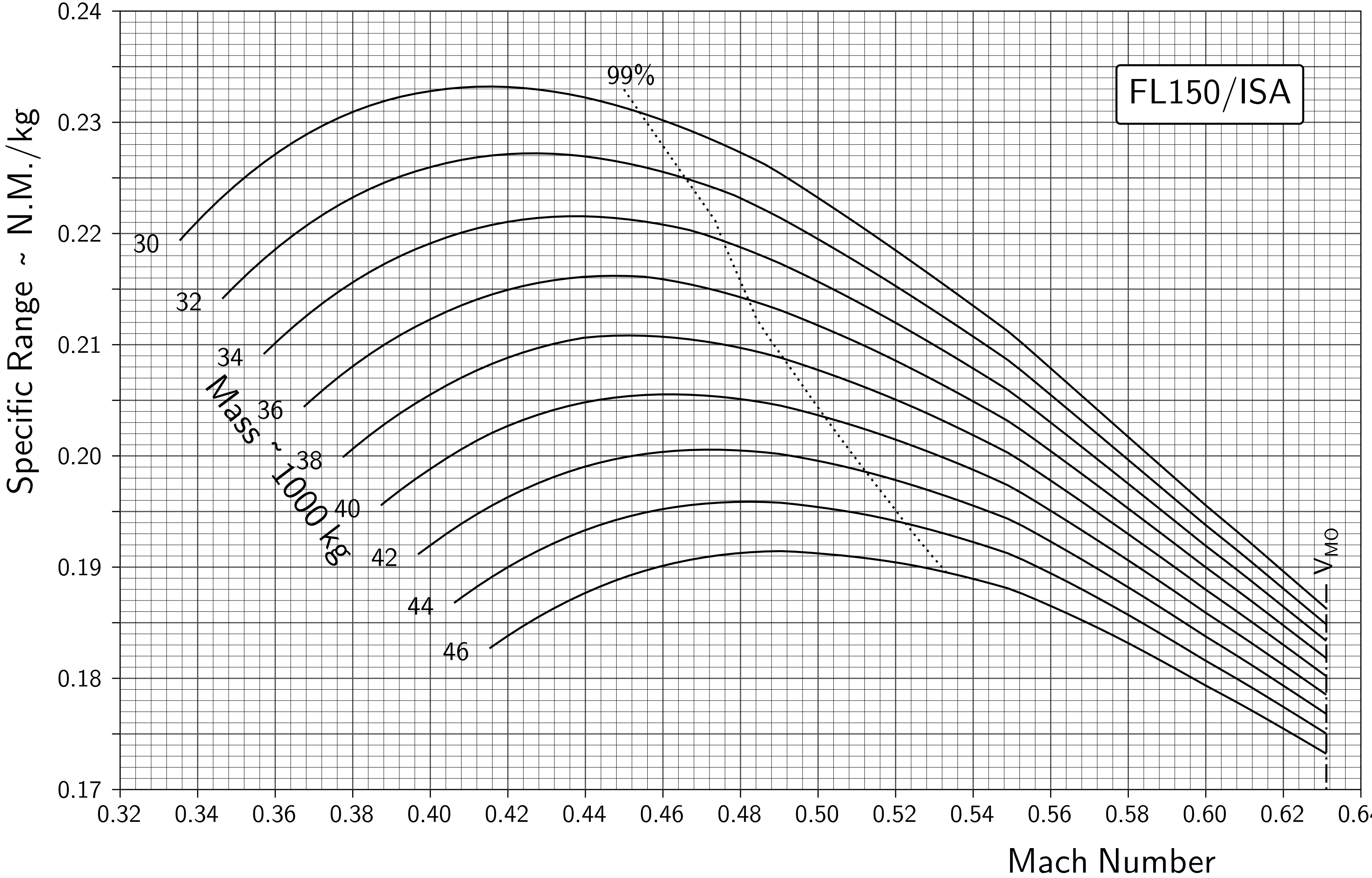

Figure 6.3: Specific range at FL150 / ISA.

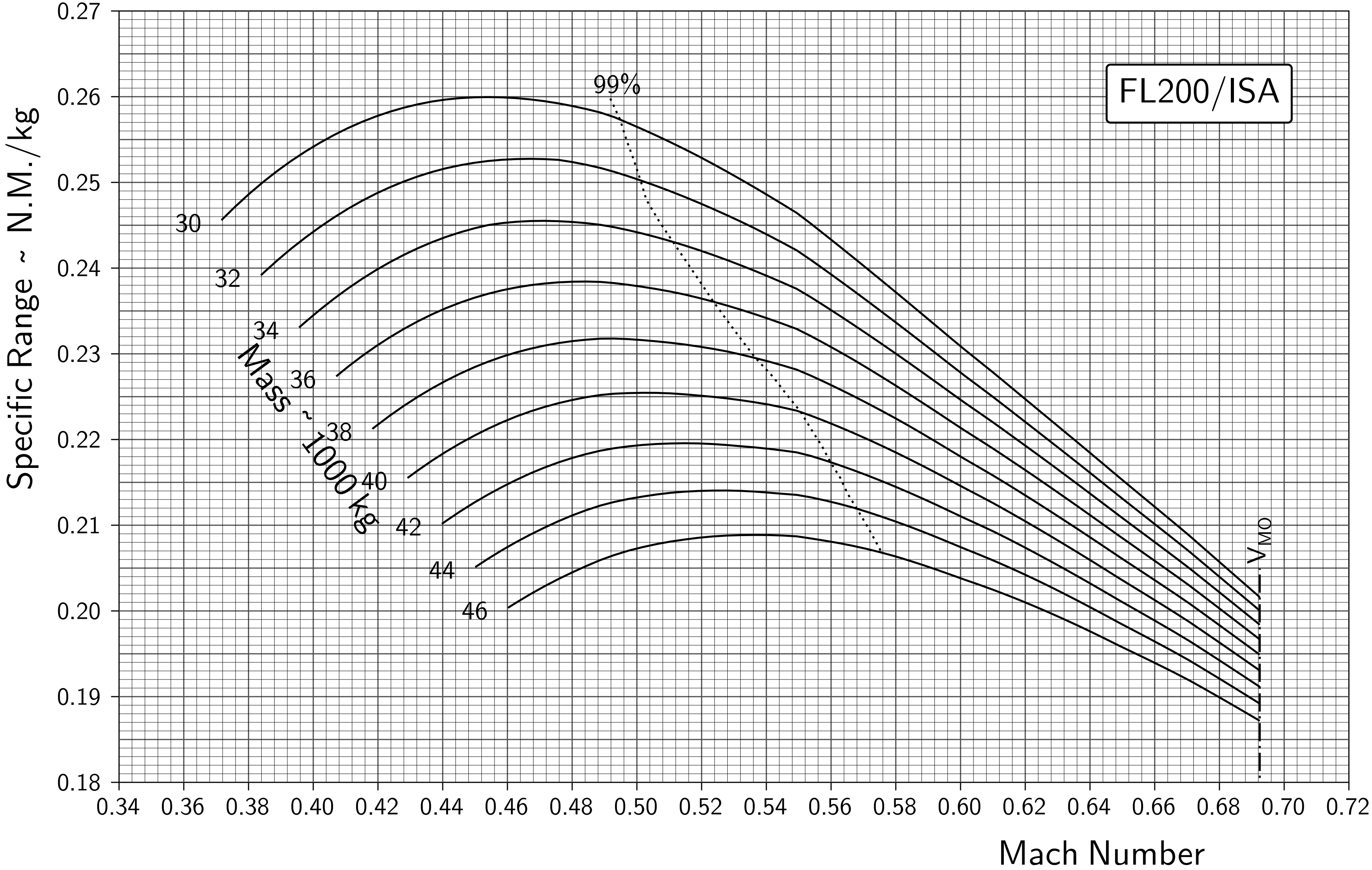

Figure 6.4: Specific range at FL200 / ISA.

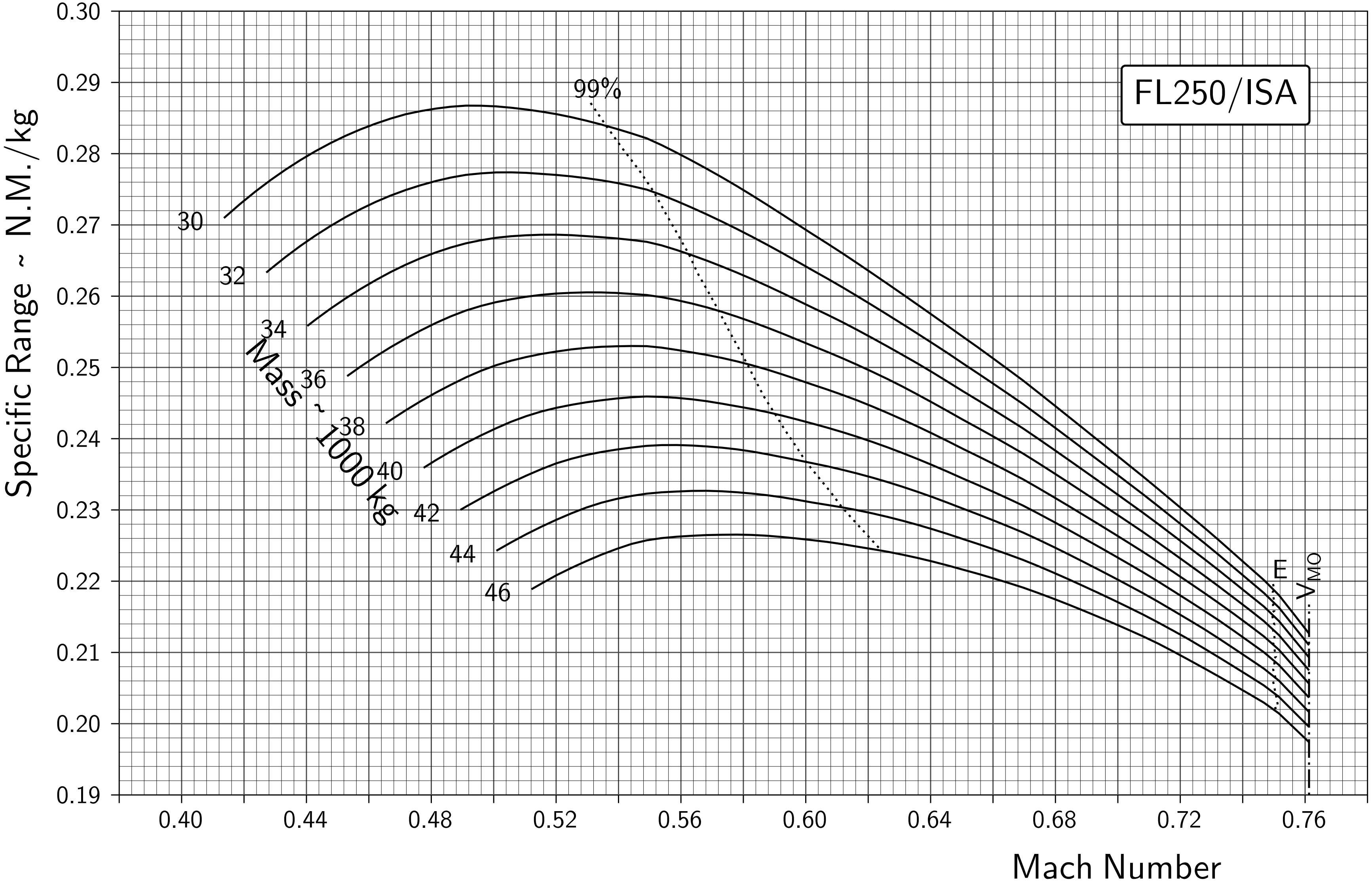

Figure 6.5: Specific range at FL250 / ISA.

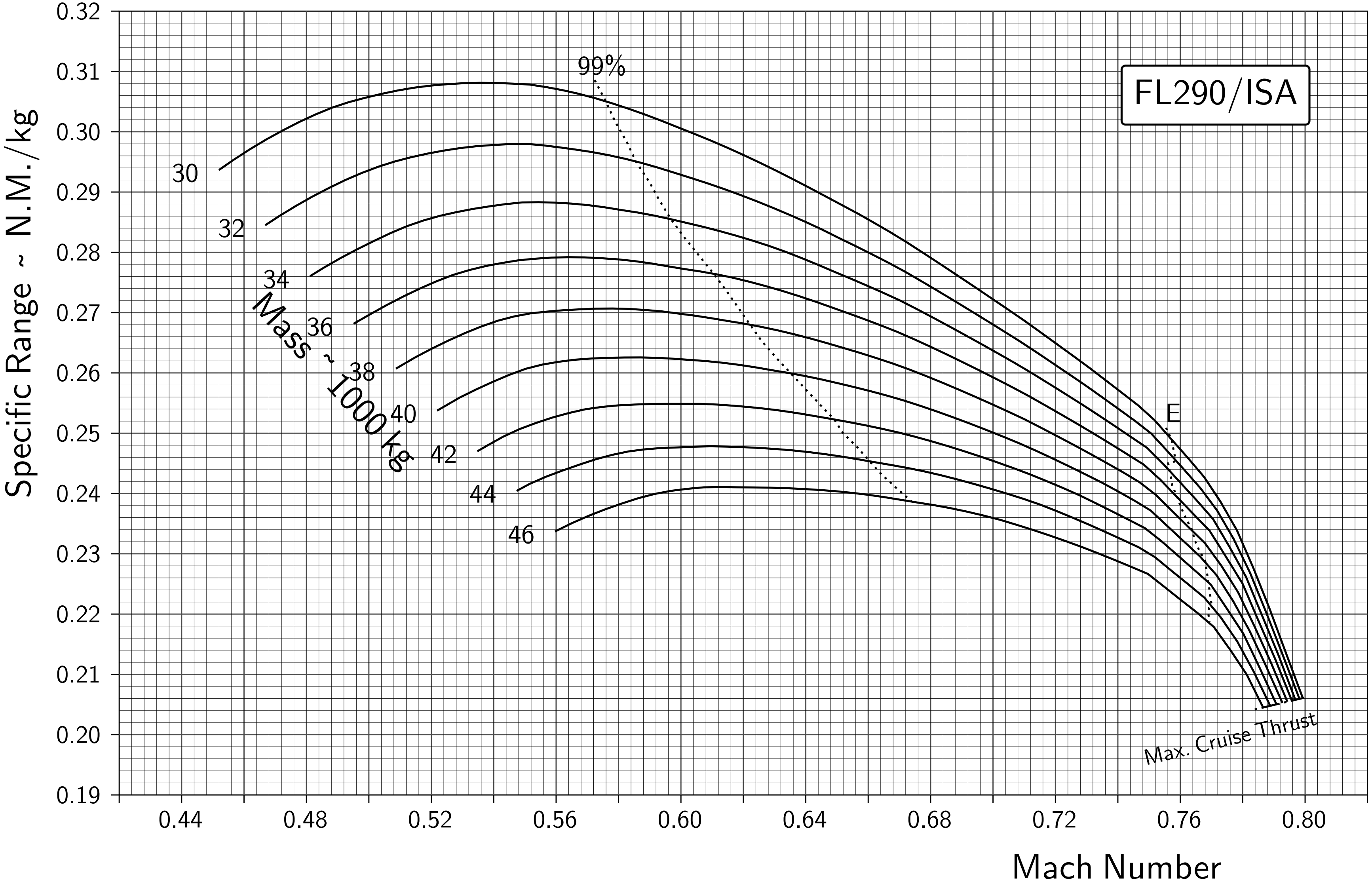

Figure 6.6: Specific range at FL290 / ISA.

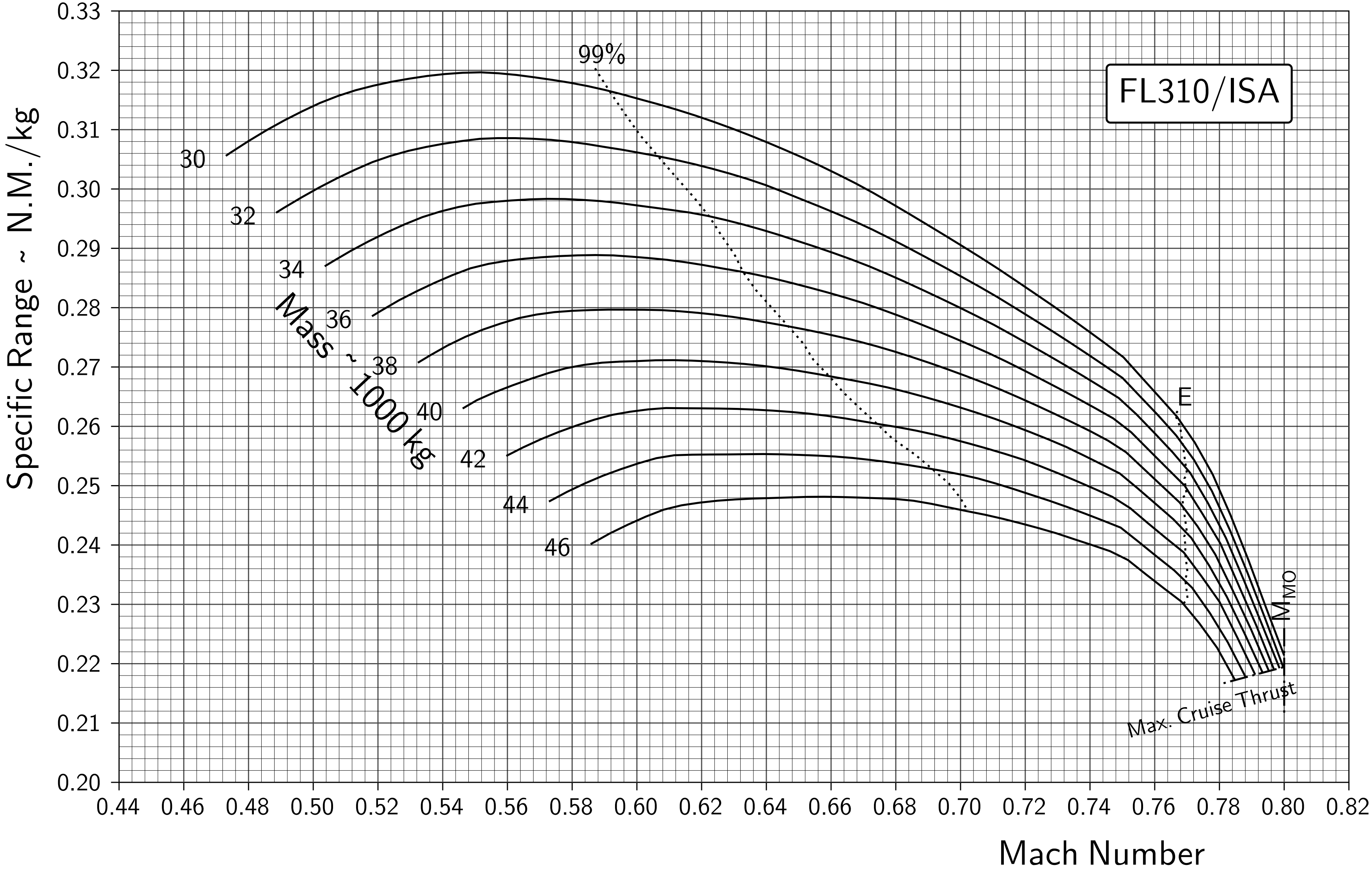

Figure 6.7: Specific range at FL310 / ISA.

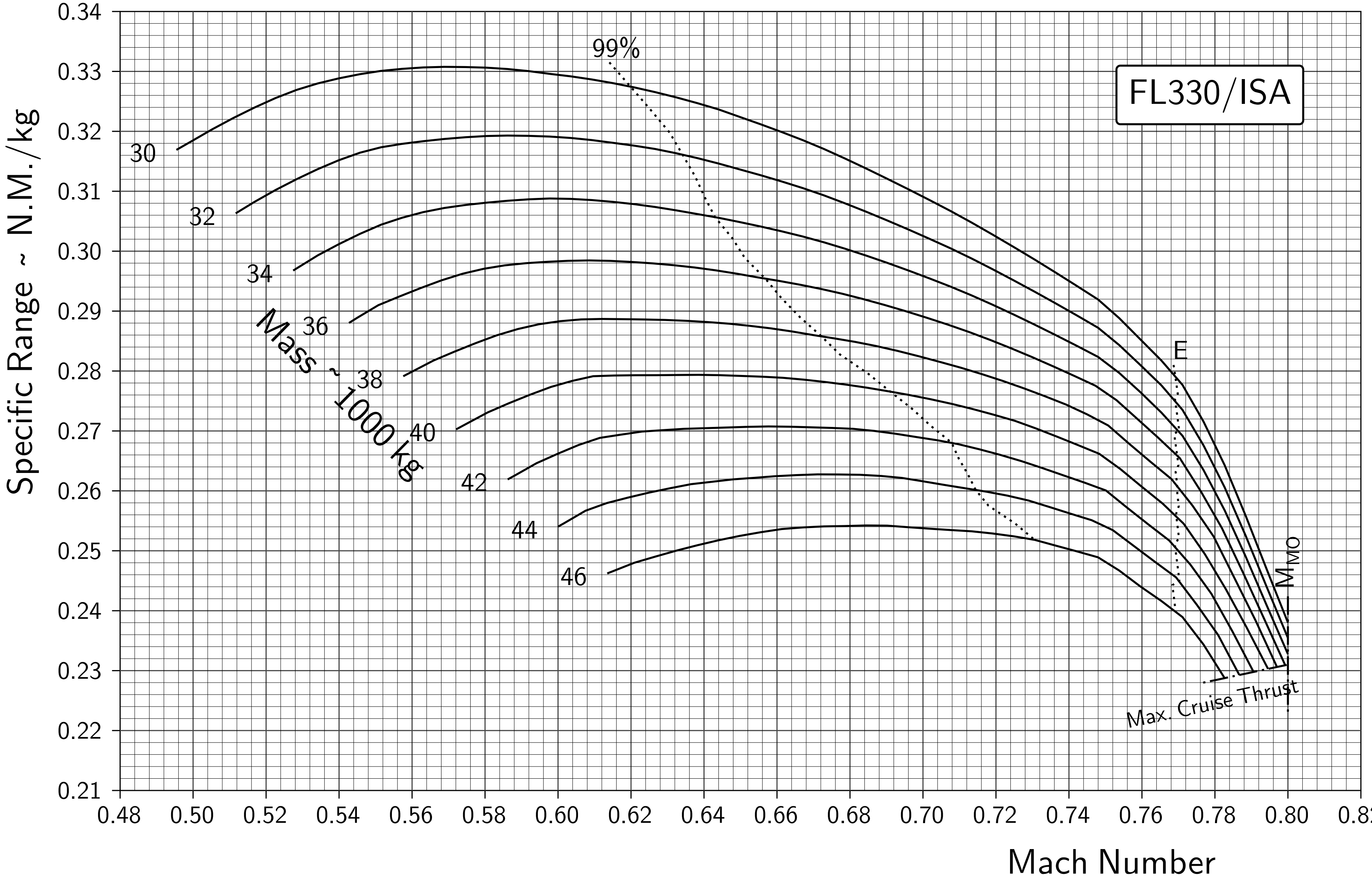

Figure 6.8: Specific range at FL330 / ISA.

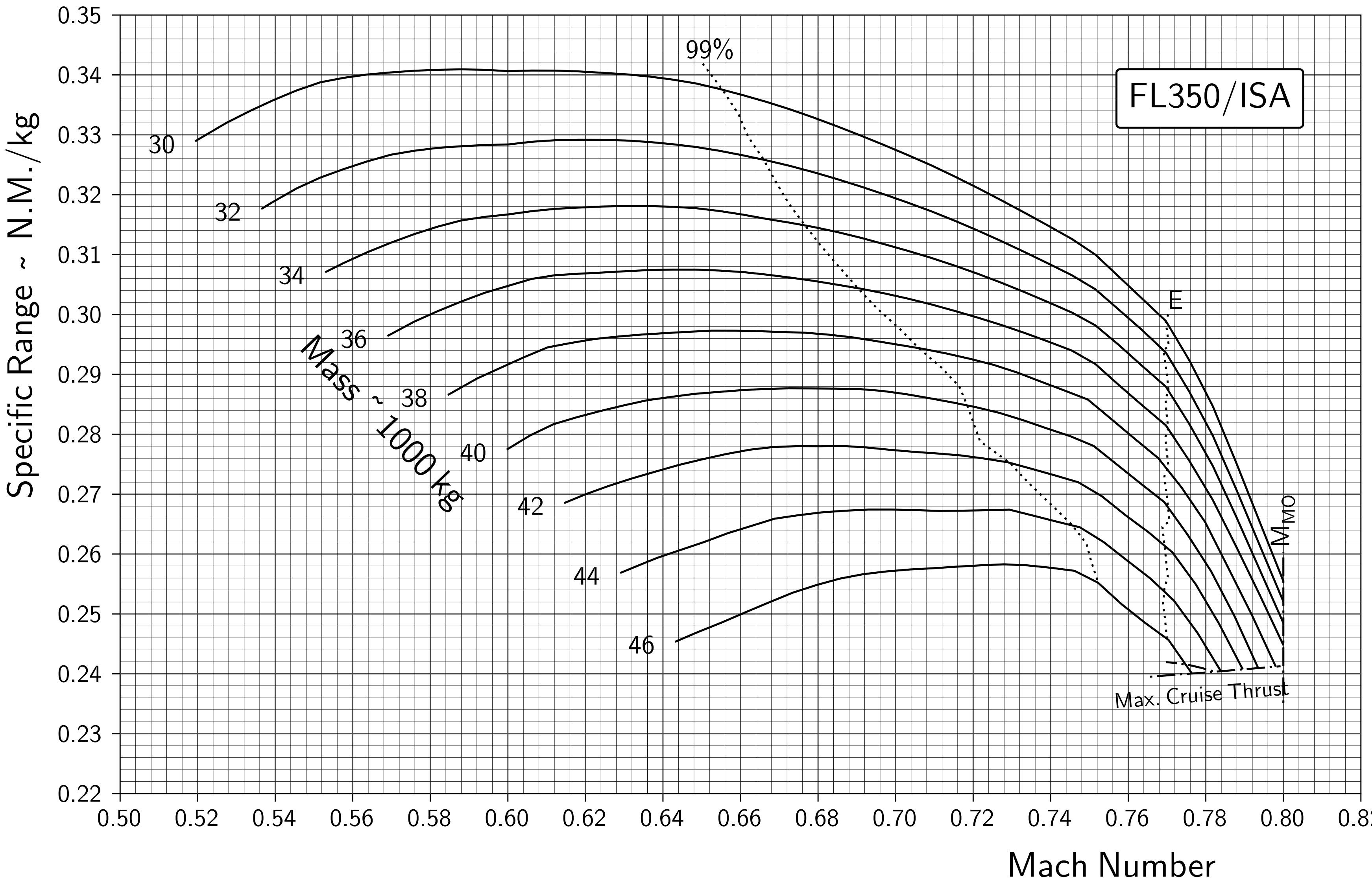

Figure 6.9: Specific range at FL350 / ISA.

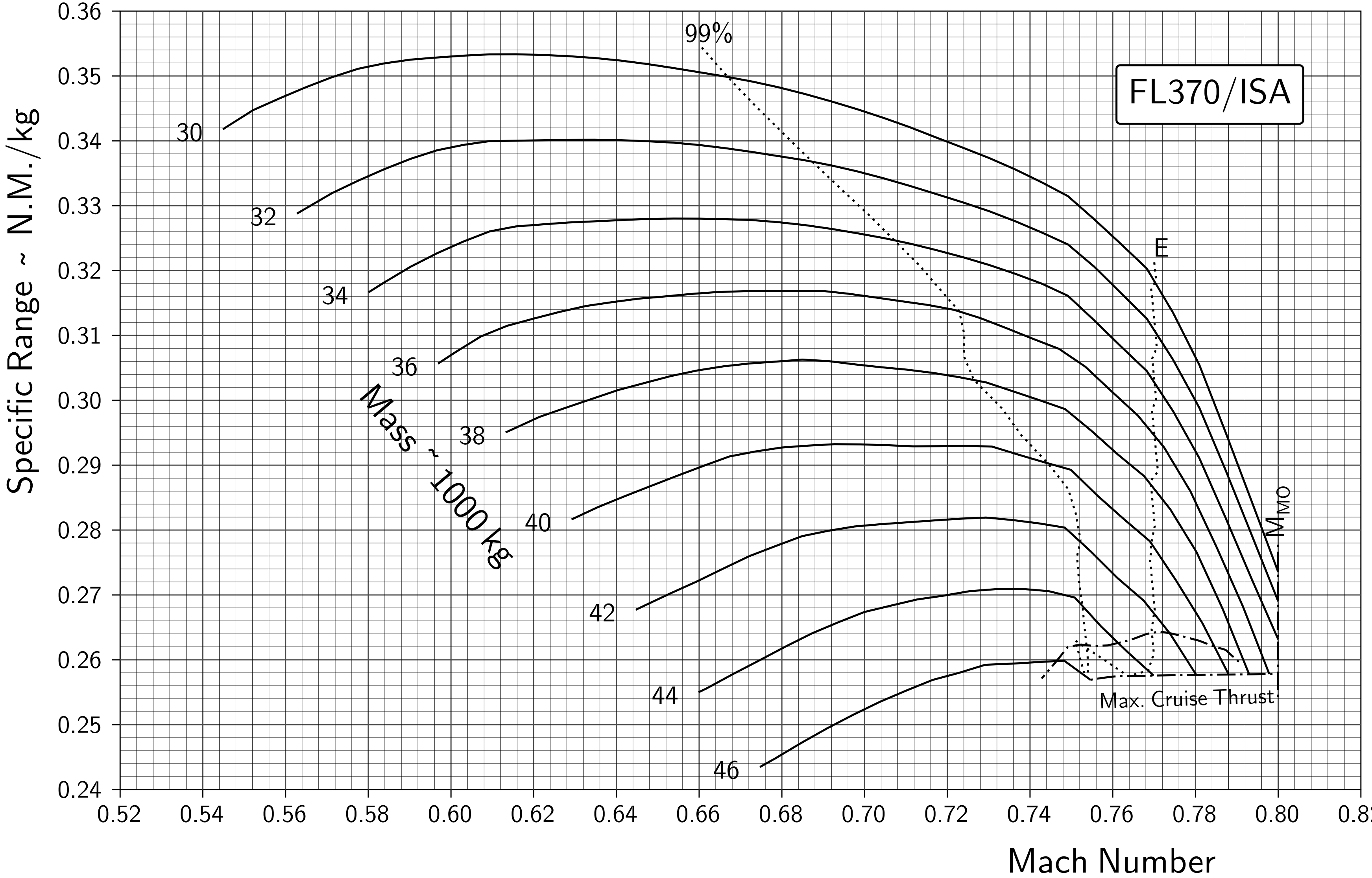

Figure 6.10: Specific range at FL370 / ISA.

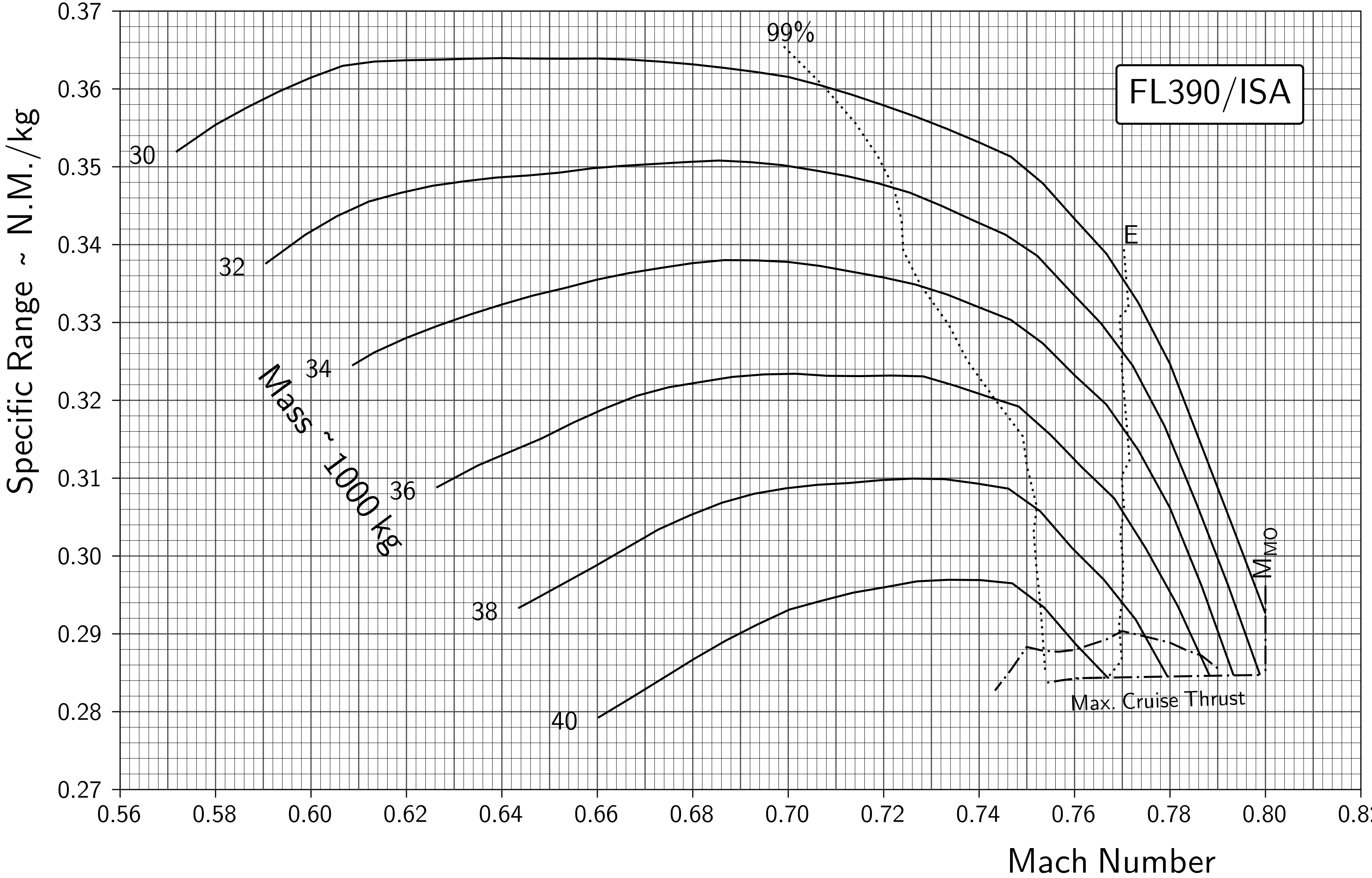

Figure 6.11: Specific range at FL390 / ISA.

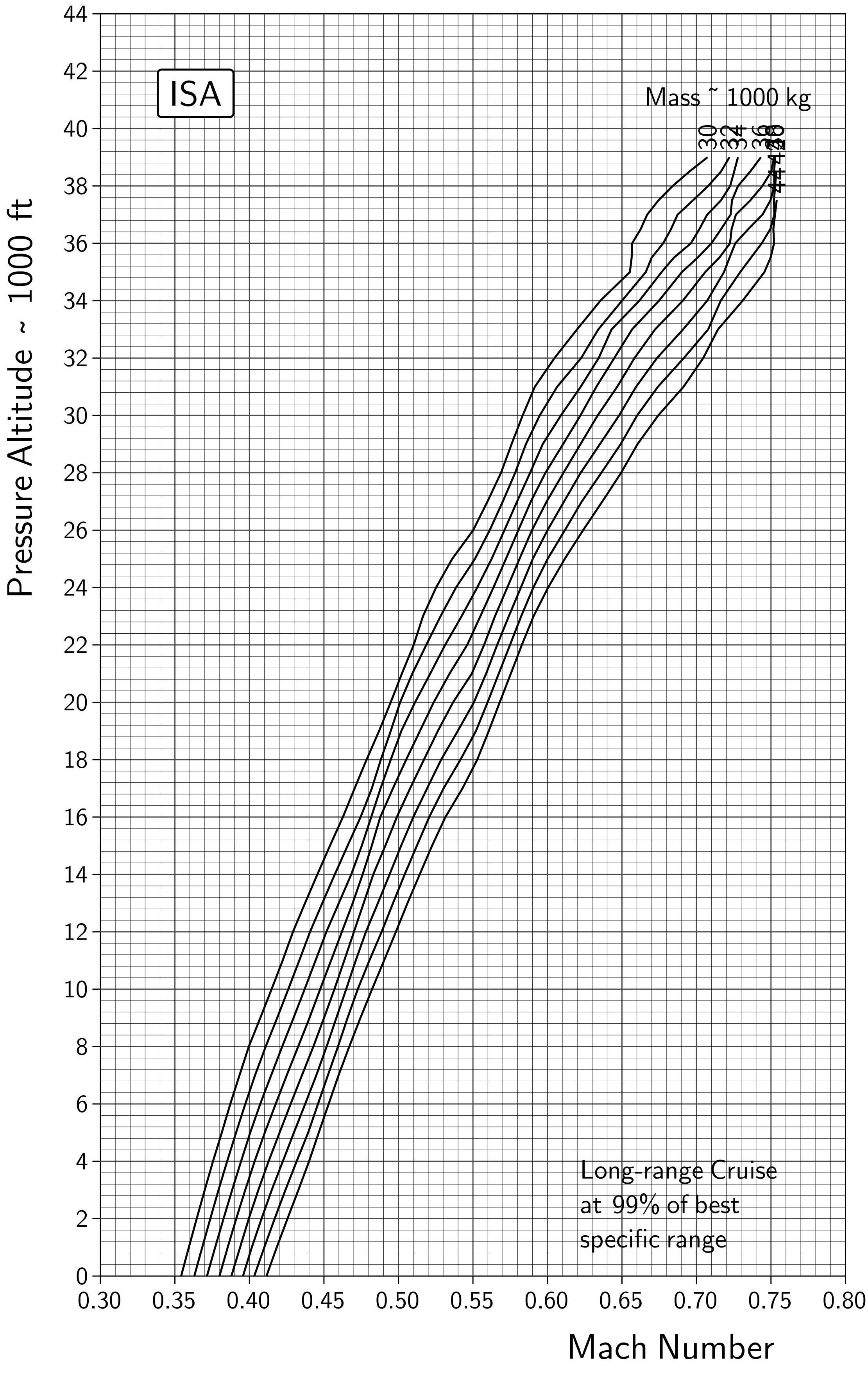

Figure 6.12: Long-range Mach Number at ISA.

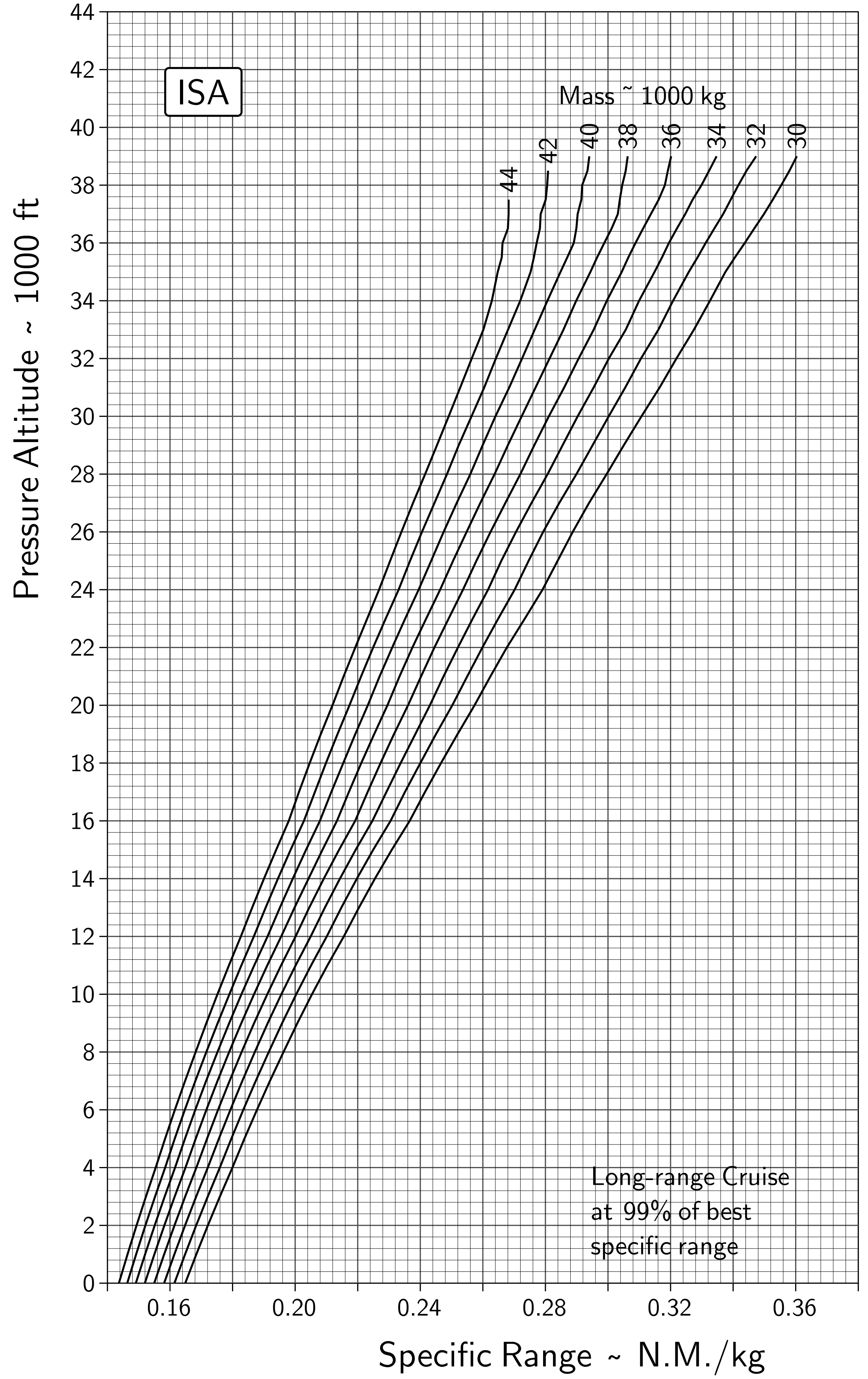

Figure 6.13: Long-range specific range at ISA.

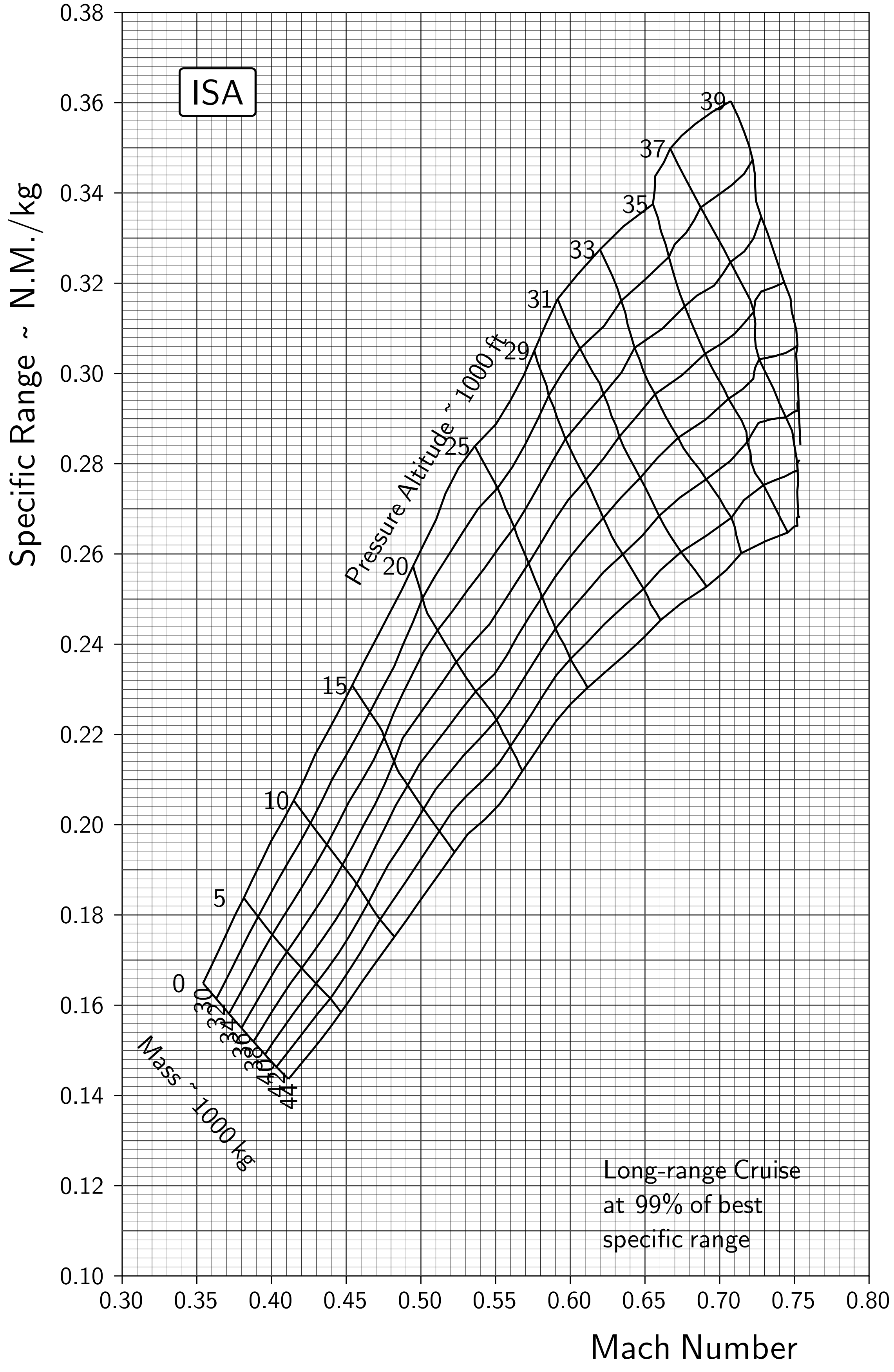

Figure 6.14: Long-range specific range composite at ISA.

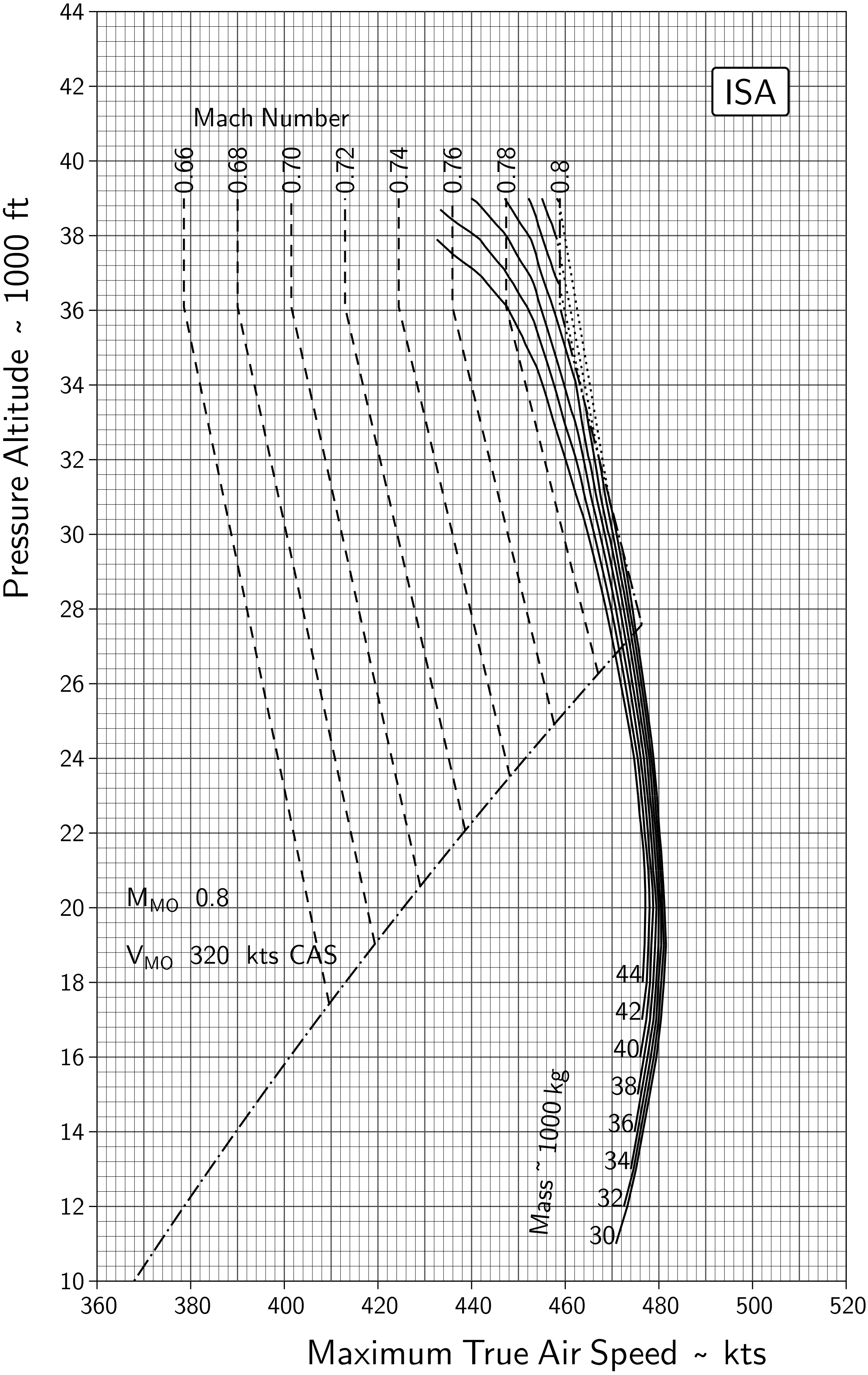

Figure 6.15: Maximum level speed at ISA.

Chapter 7

Descent

Assumptions

Operational speed restriction of 250 kts **CAS** below 10 000 ft.
Maximum aircraft rate of descent 3 000 ft/min.
Maximum cabin rate of descent 300 ft/min.
No wind.

Figures

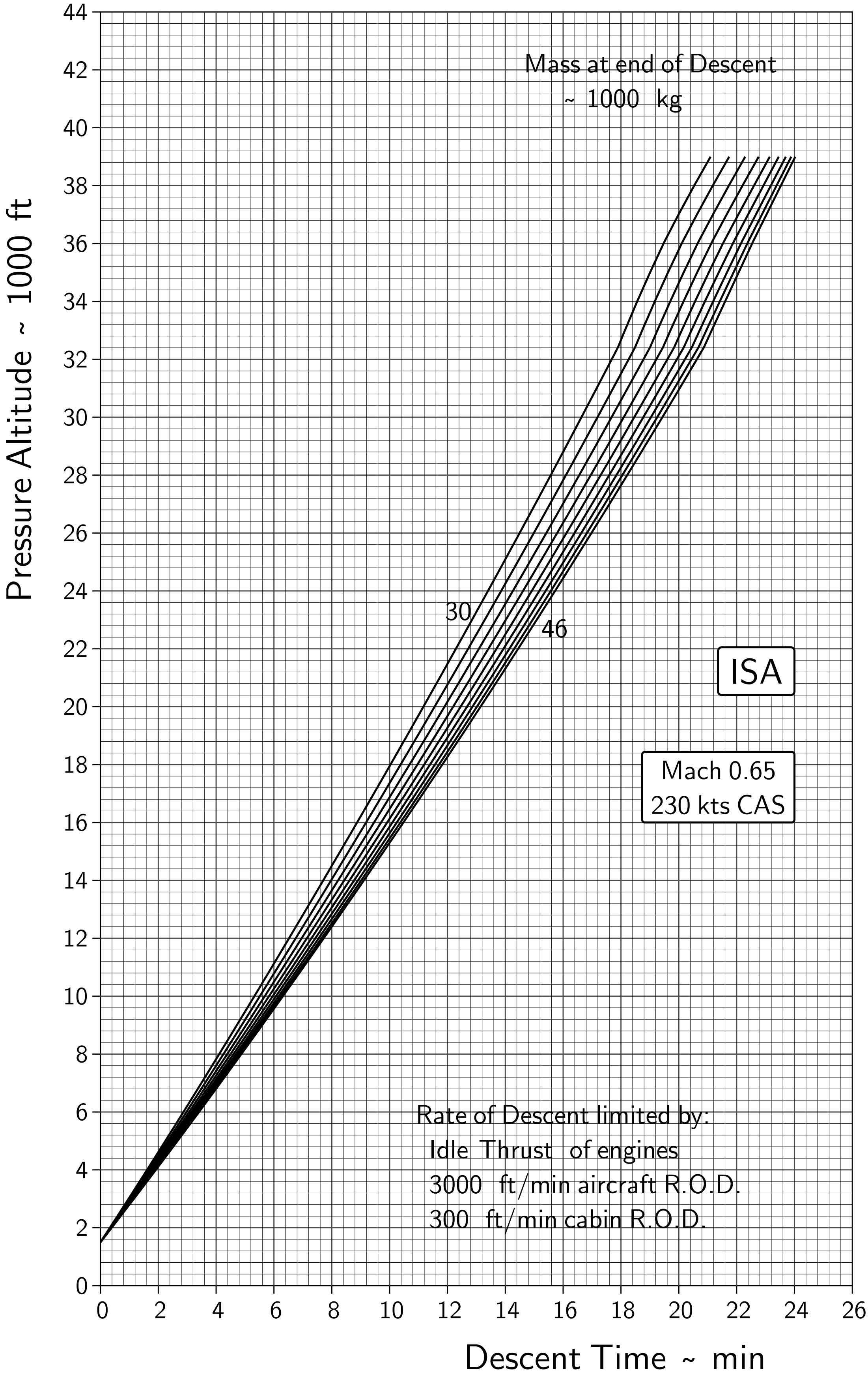

Figure 7.1: Descent time at 230 kts CAS / Mach 0.65 at ISA.

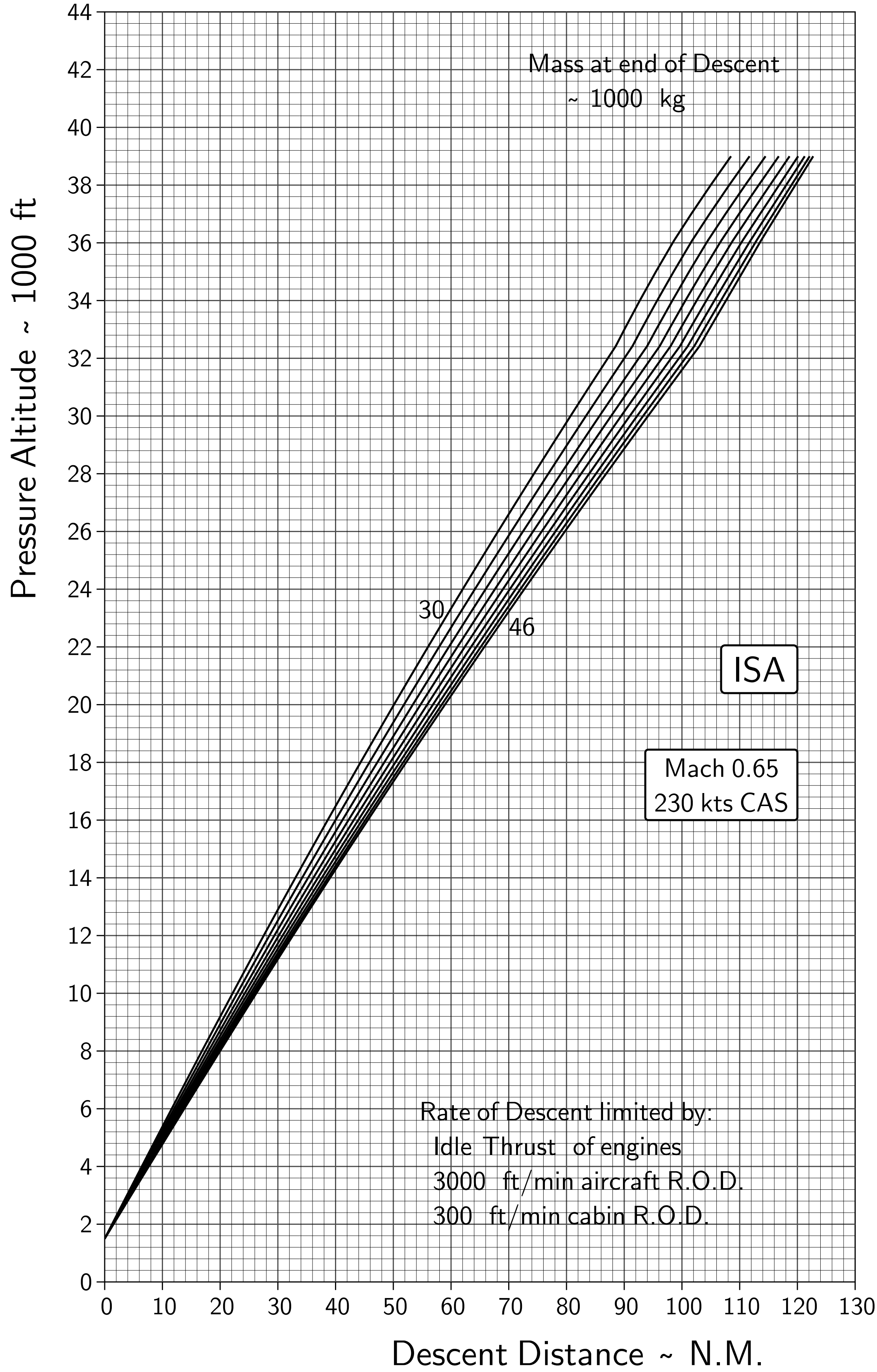

Figure 7.2: Descent distance at 230 kts CAS / Mach 0.65 at ISA.

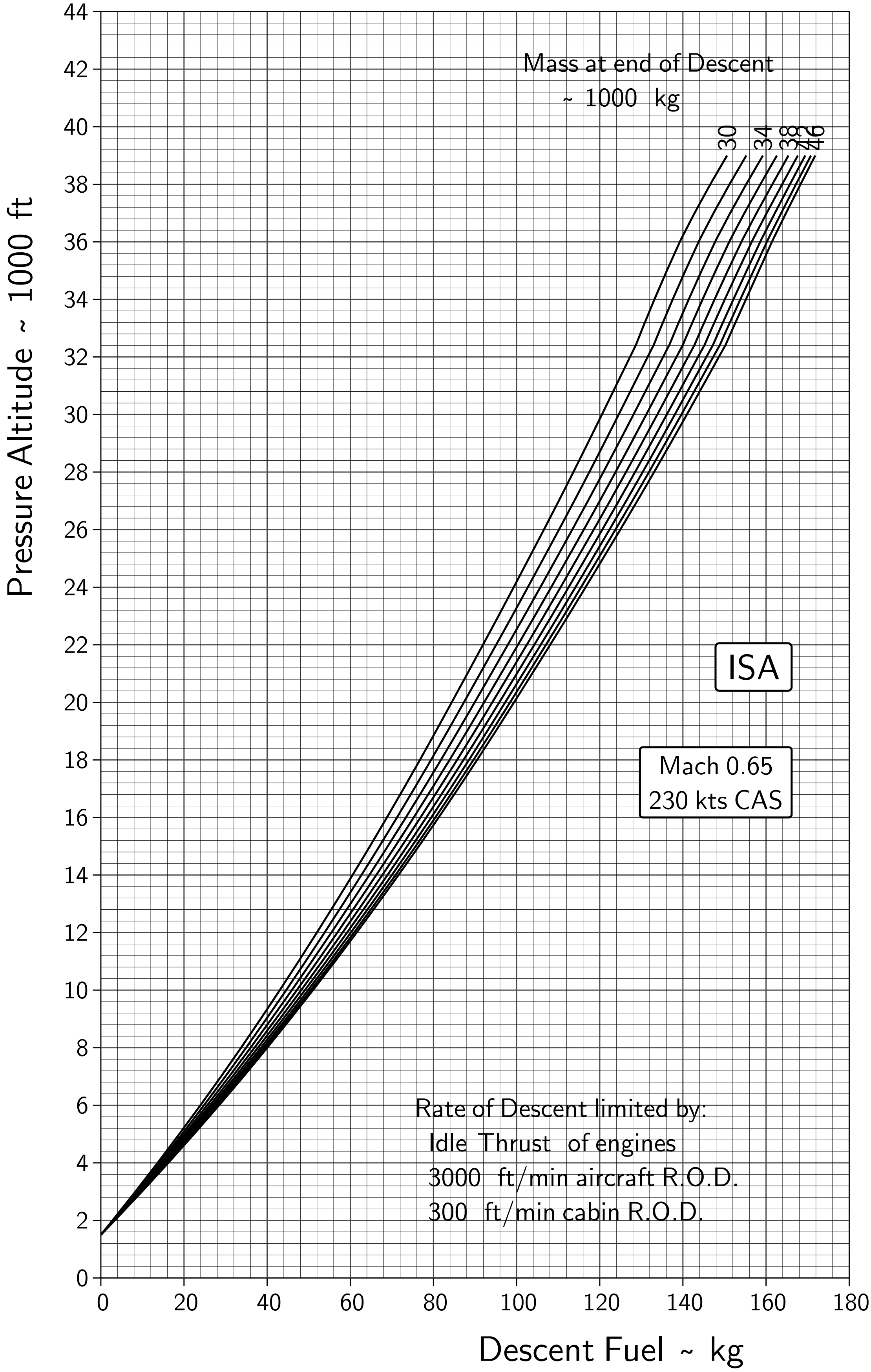

Figure 7.3: Descent fuel at 230 kts CAS / Mach 0.65 at ISA.

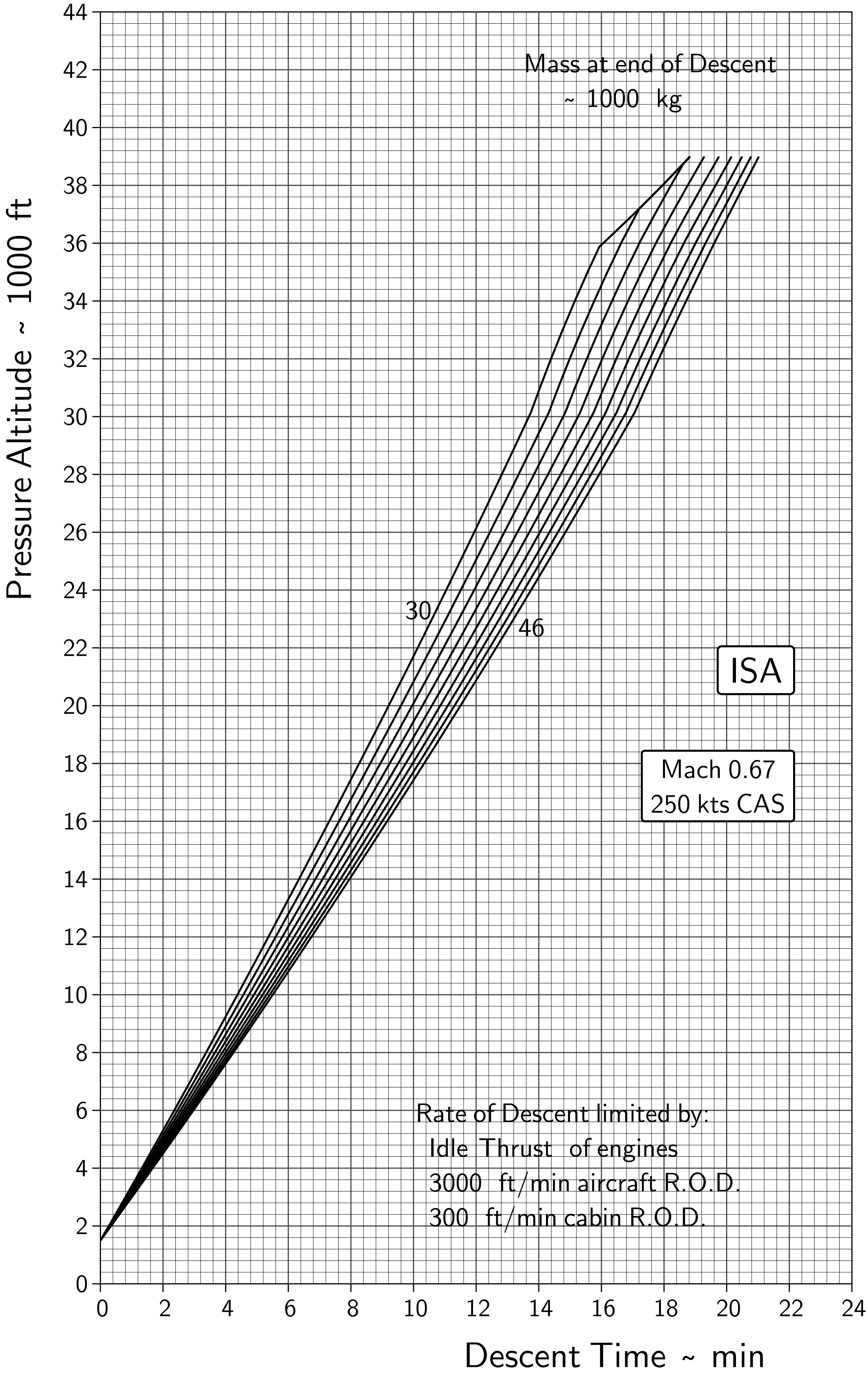

Figure 7.4: Descent time at 250 kts CAS / Mach 0.67 at ISA.

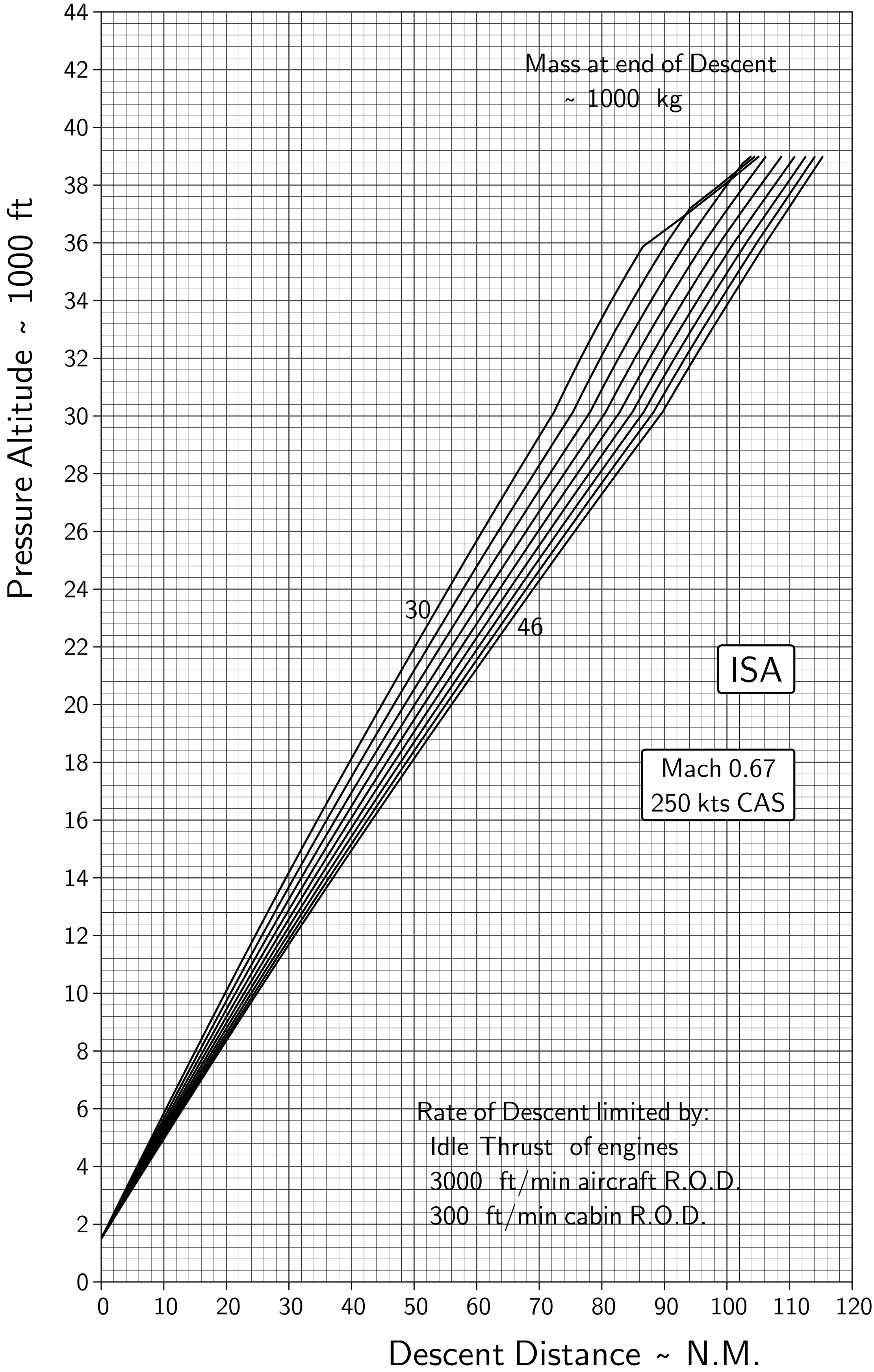

Figure 7.5: Descent distance at 250 kts CAS / Mach 0.67 at ISA.

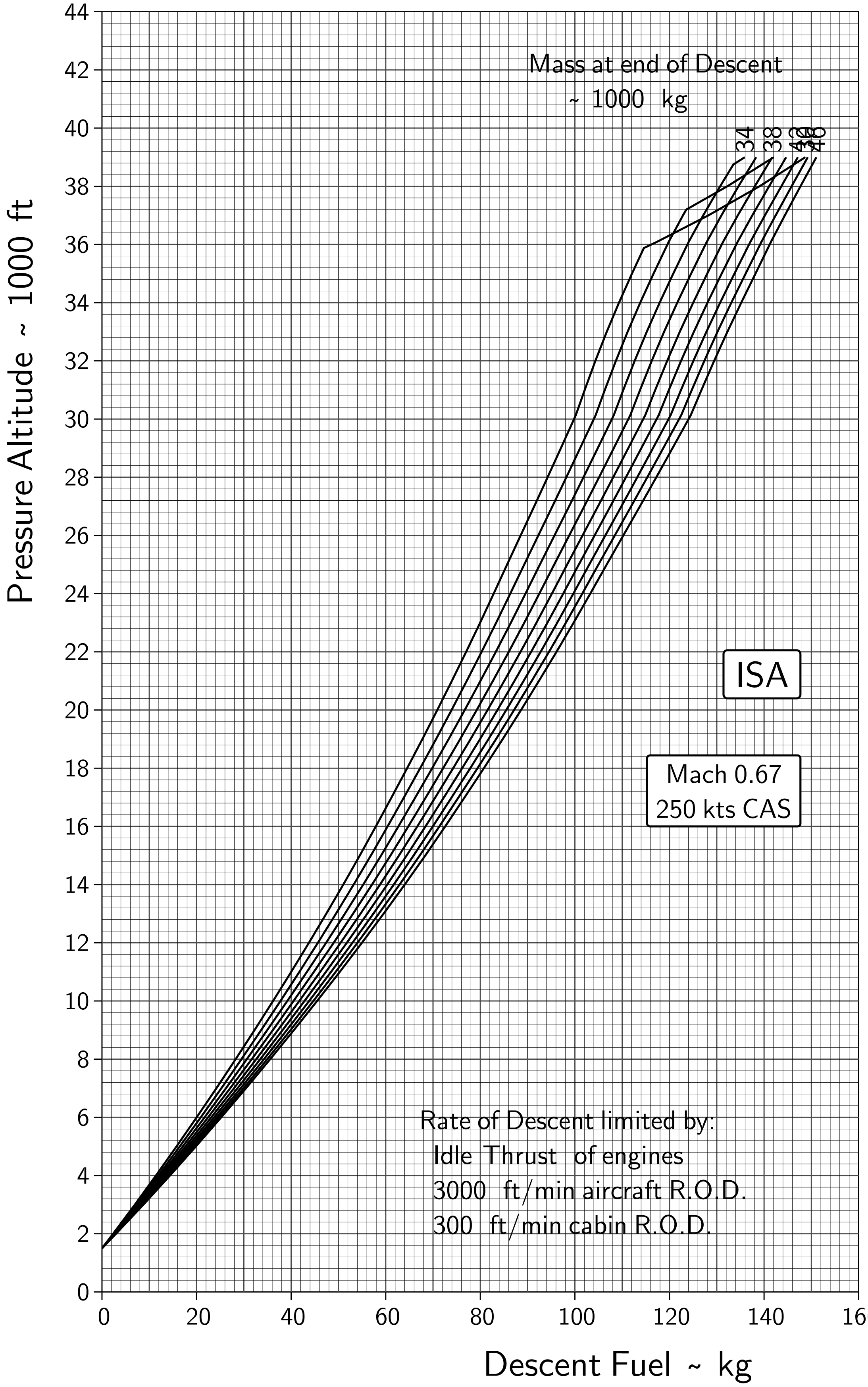

Figure 7.6: Descent fuel at 250 kts CAS / Mach 0.67 at ISA.

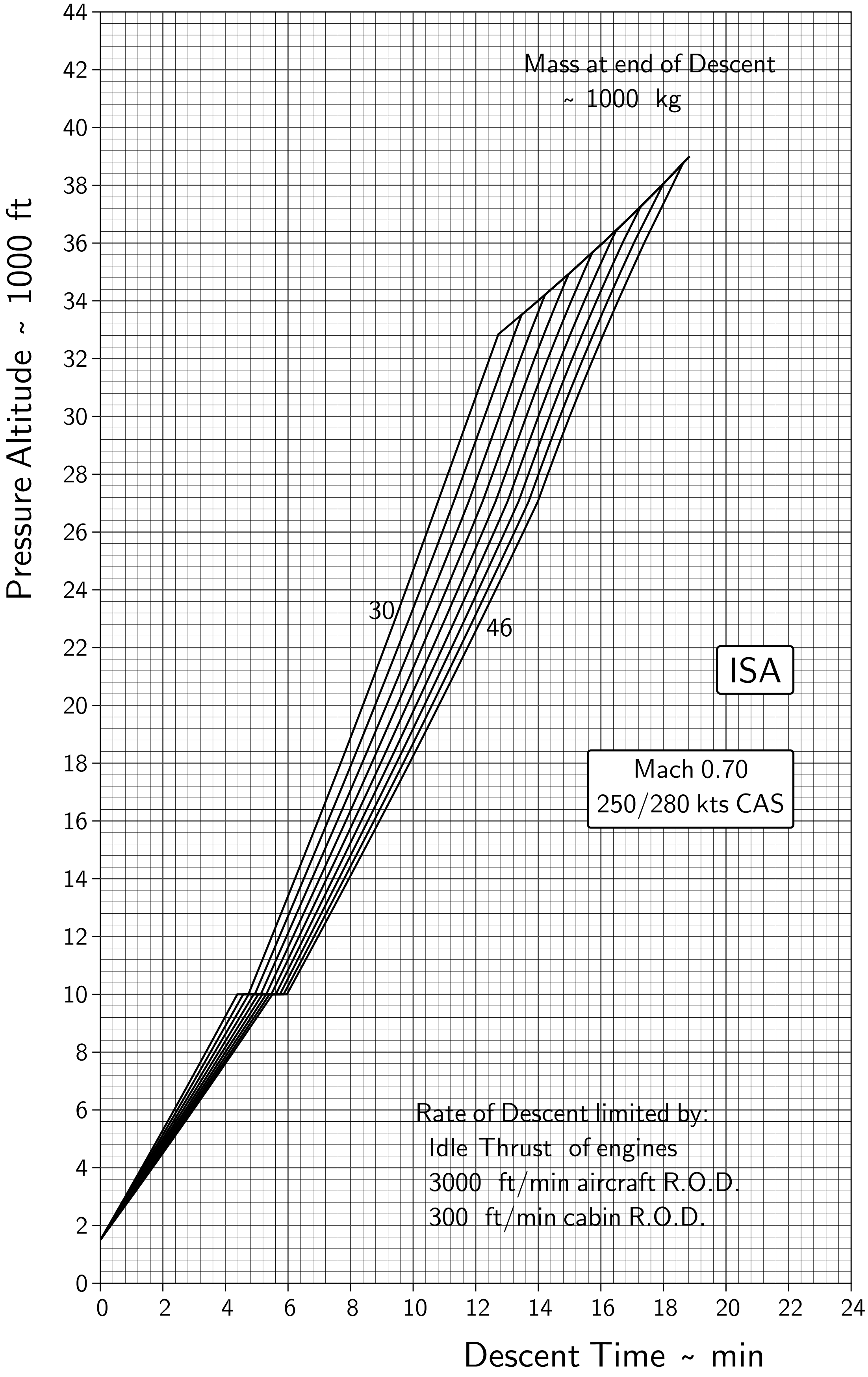

Figure 7.7: Descent time at 250/280 kts CAS / Mach 0.70 at ISA.

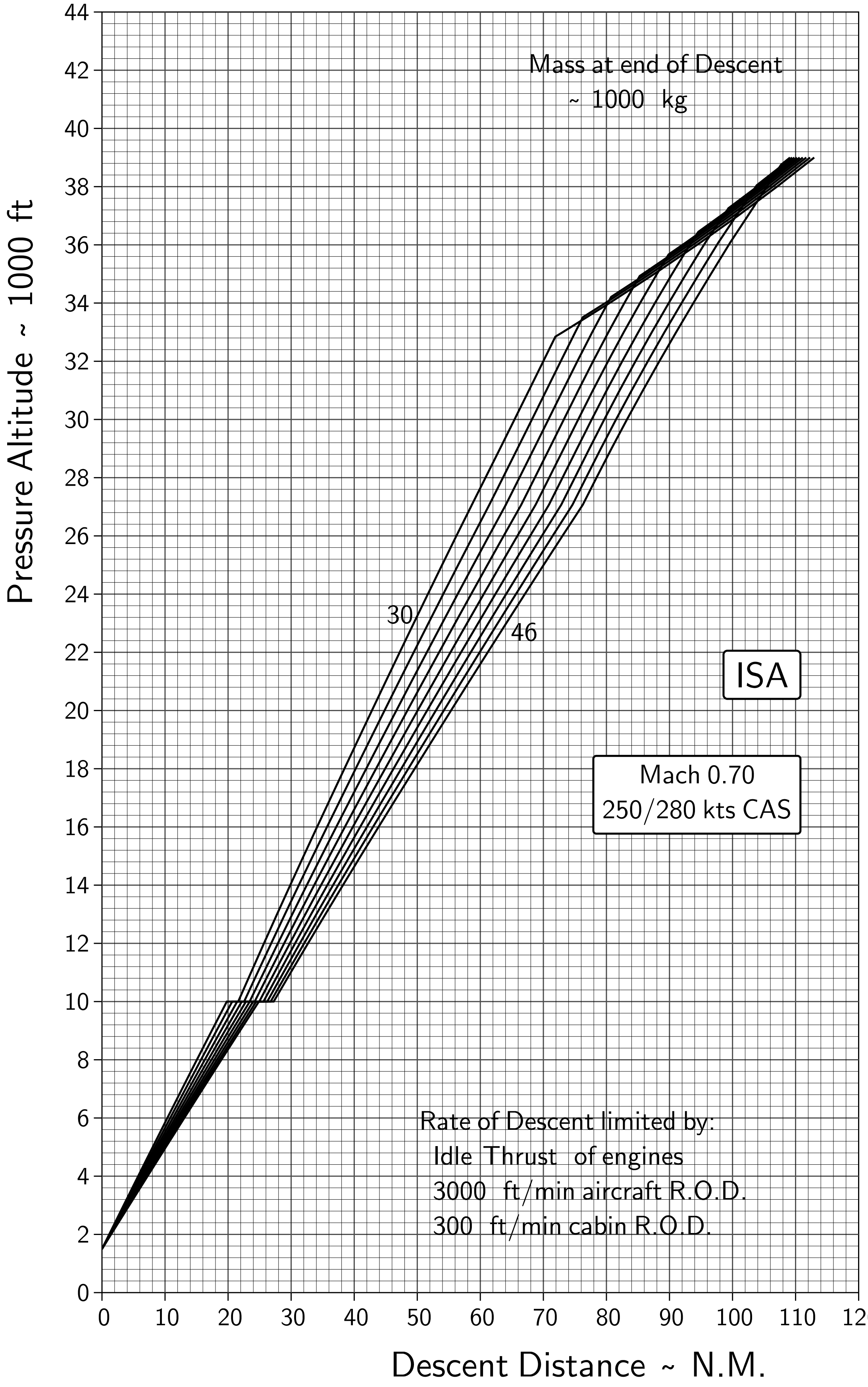

Figure 7.8: Descent distance at 250/280 kts CAS / Mach 0.70 at ISA.

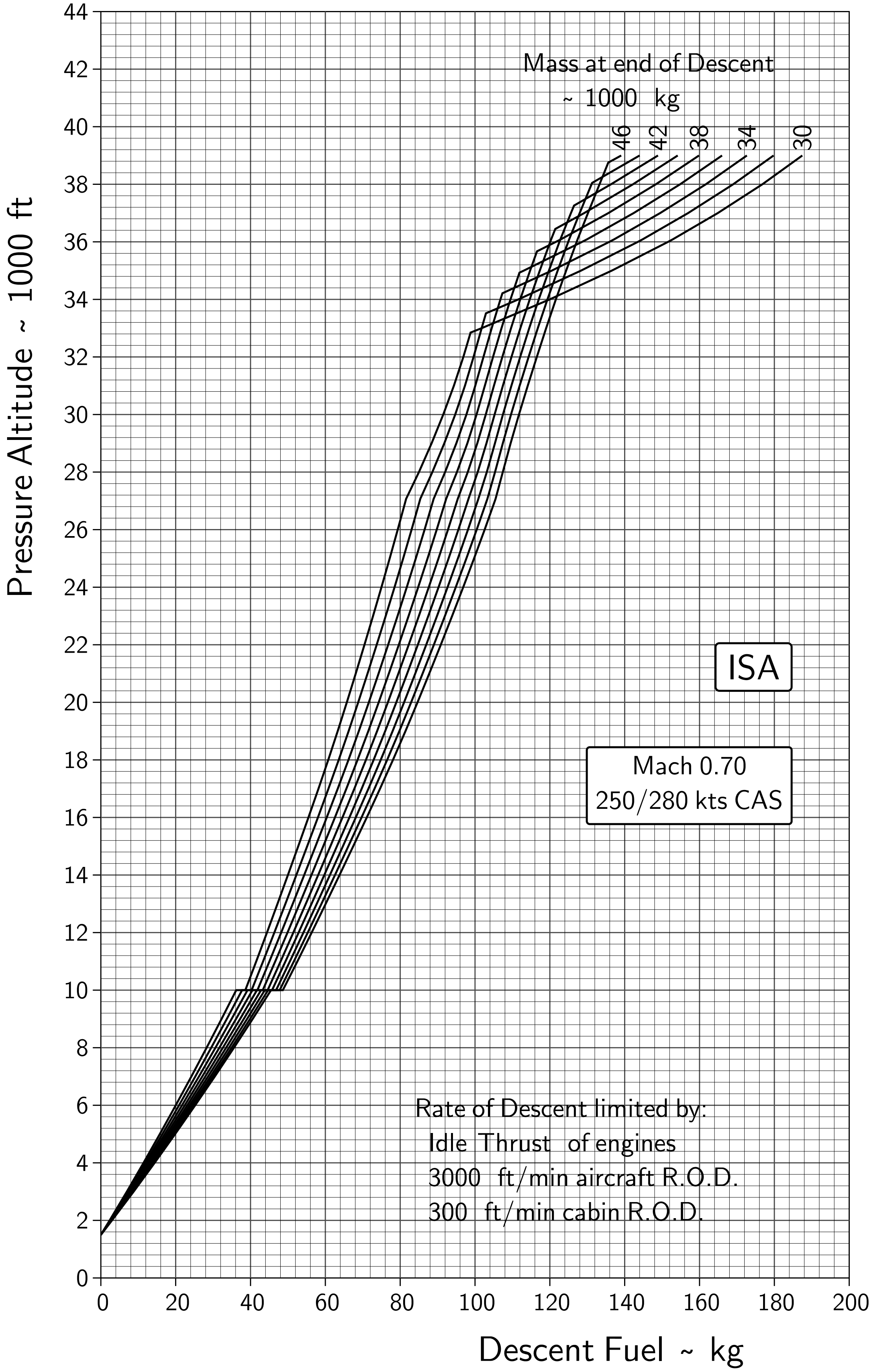

Figure 7.9: Descent fuel at 250/280 kts CAS / Mach 0.70 at ISA.

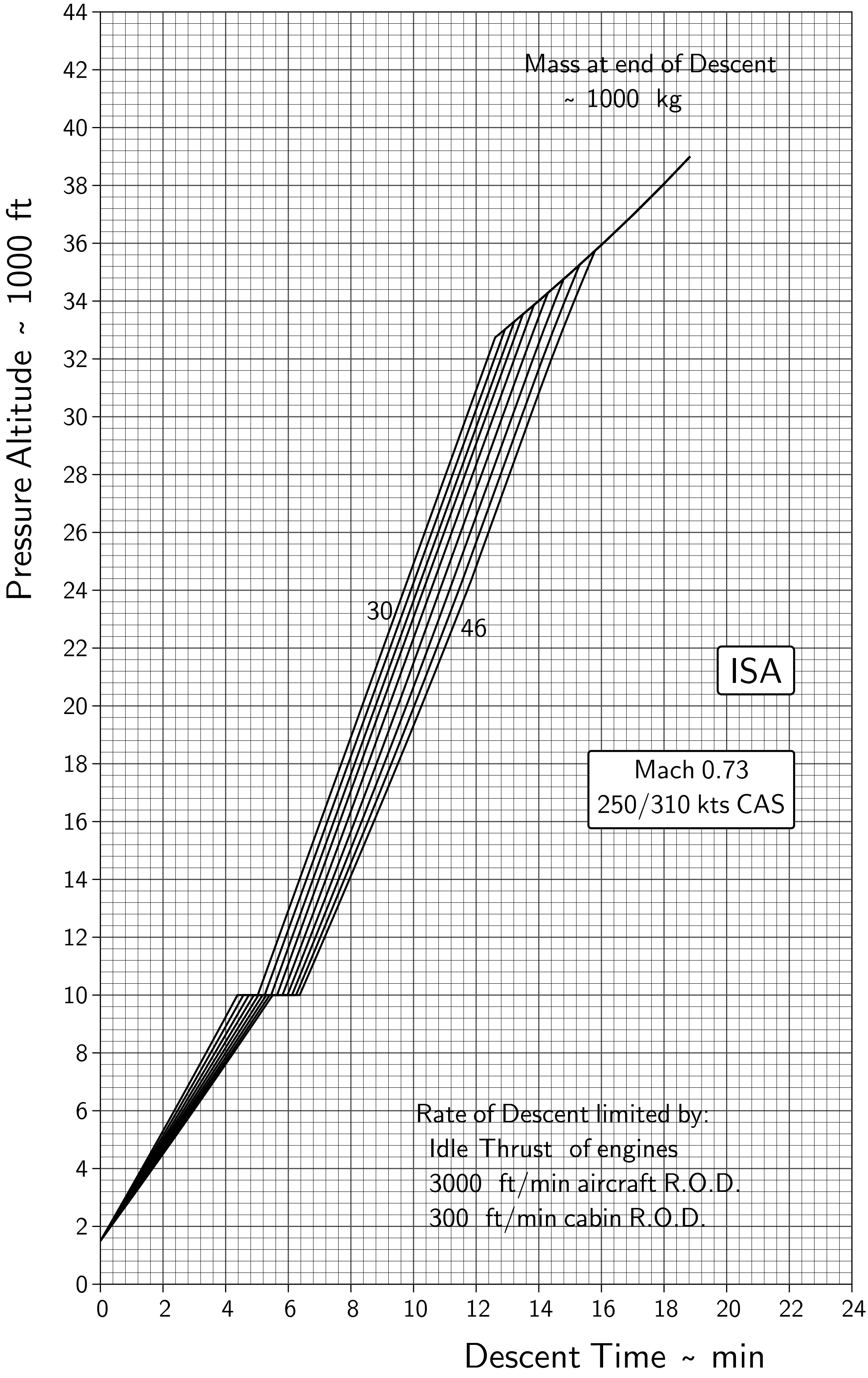

Figure 7.10: Descent time at 250/310 kts CAS / Mach 0.73 at ISA.

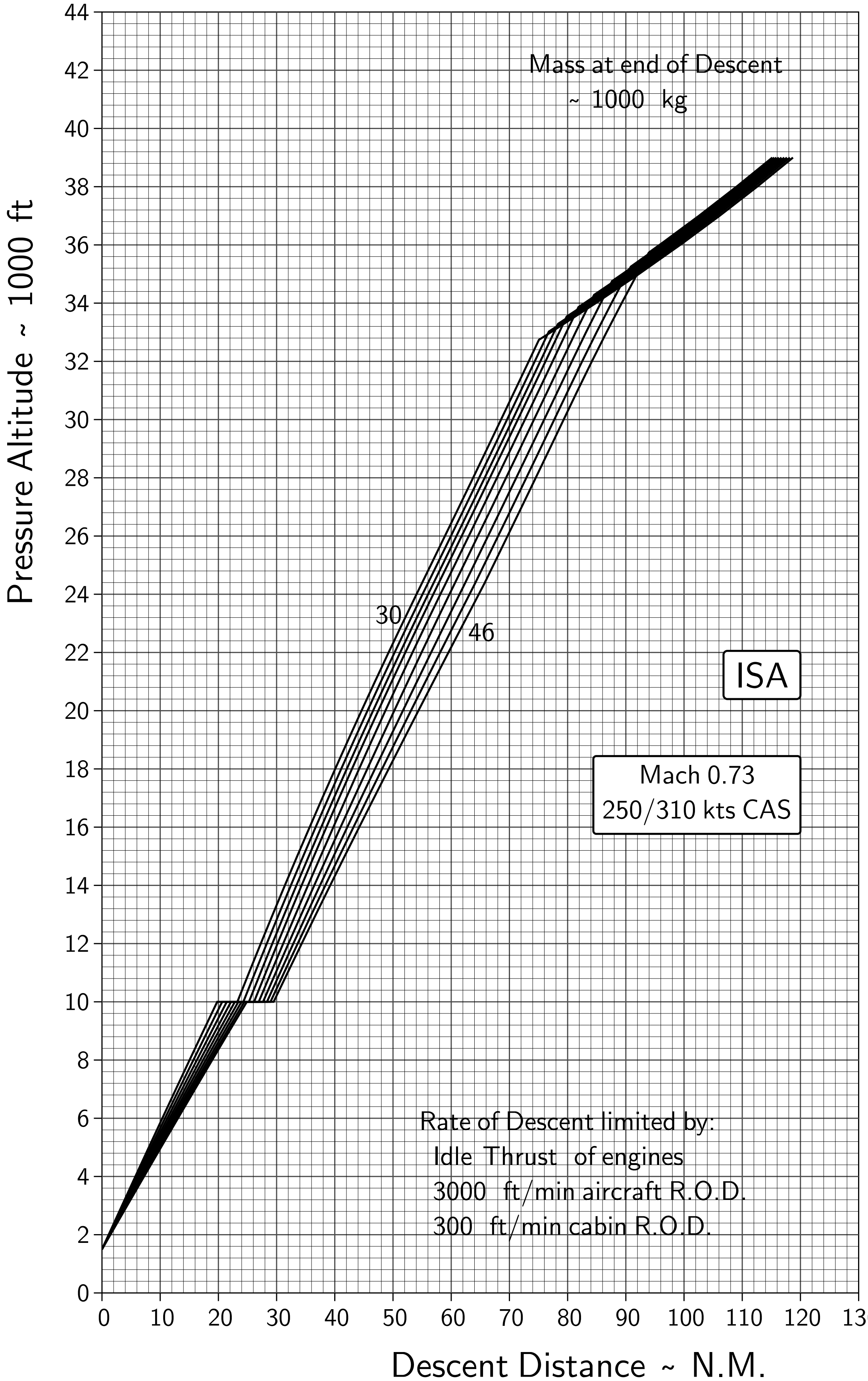

Figure 7.11: Descent distance at 250/310 kts CAS / Mach 0.73 at ISA.

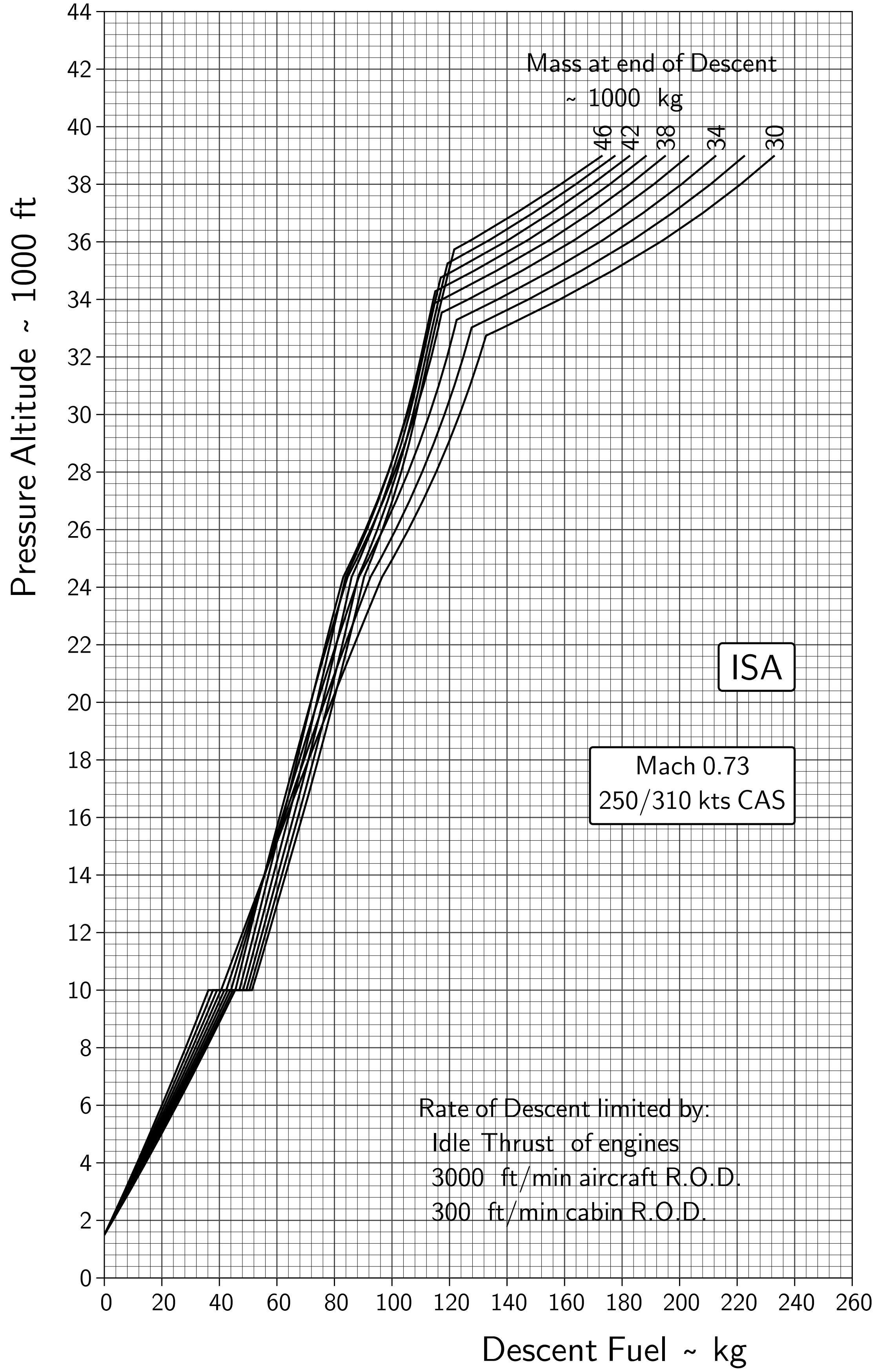

Figure 7.12: Descent fuel at 250/310 kts CAS / Mach 0.73 at ISA.

Chapter 8

Holding

Assumptions

Holding at minimum-drag speed.

Figures

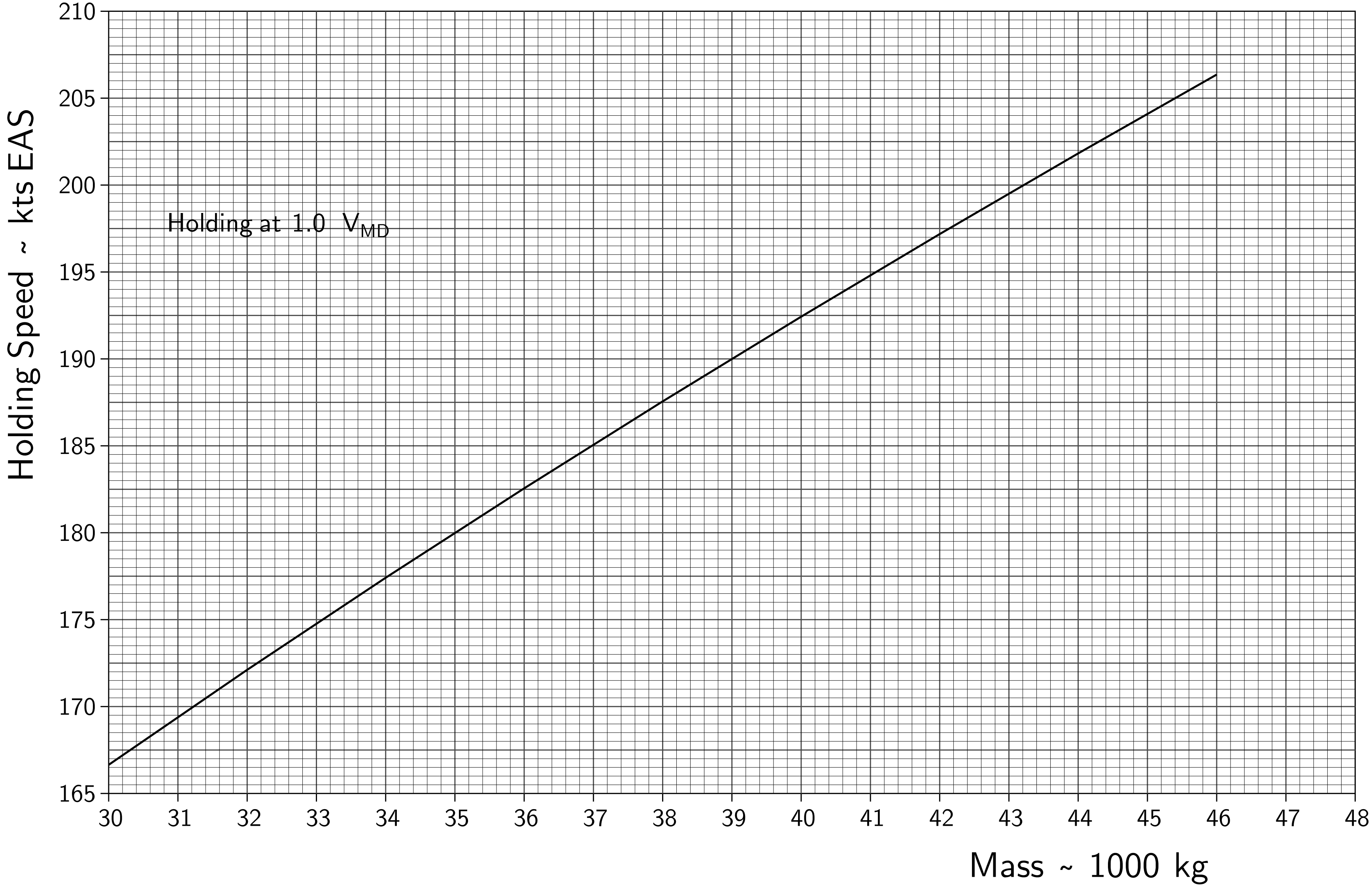

Figure 8.1: Holding speed.

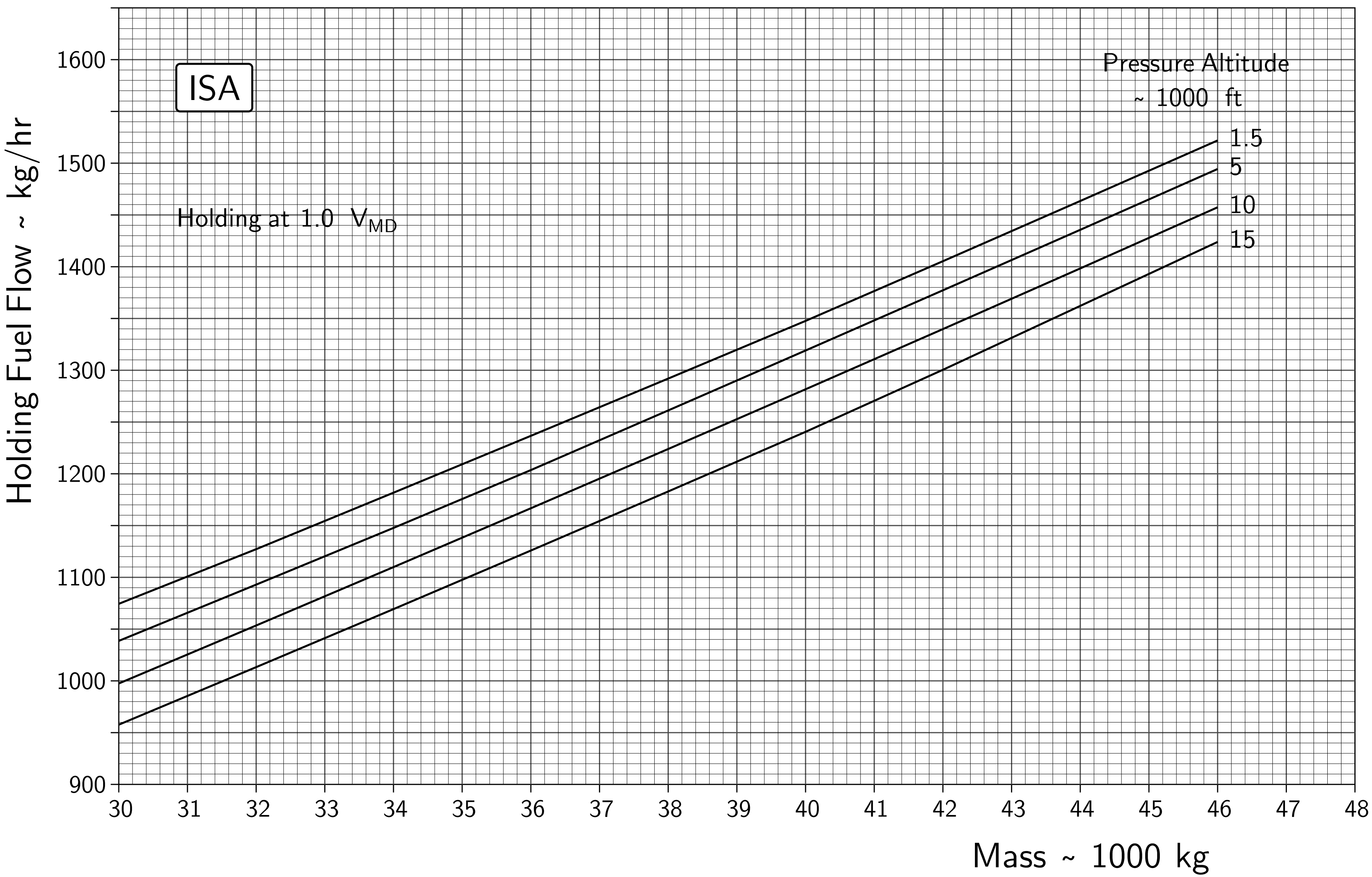

Figure 8.2: Holding fuel flow at ISA.

Chapter 9

Allowances

Assumptions

Taxi with all engines at maximum take-off mass.
Take-off includes take-off, climb-out to 1 500 ft and acceleration to climb speed.
Approach includes deceleration and approach from 1 500 ft for a total time of 6.0 min.
Overshoot includes overshoot, climb-out to 1 500 ft and acceleration to climb speed.

Figures

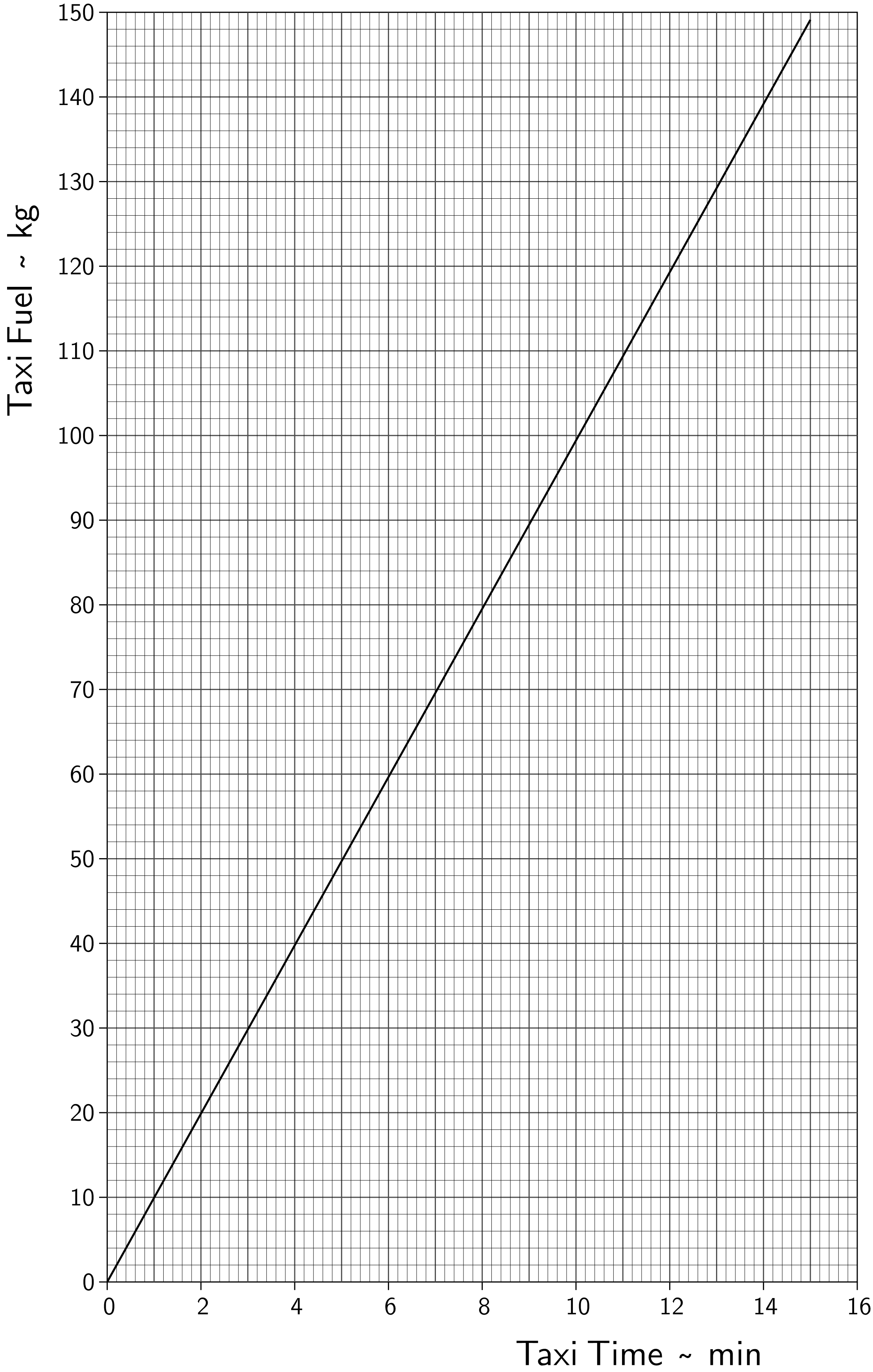

Figure 9.1: Taxi fuel.

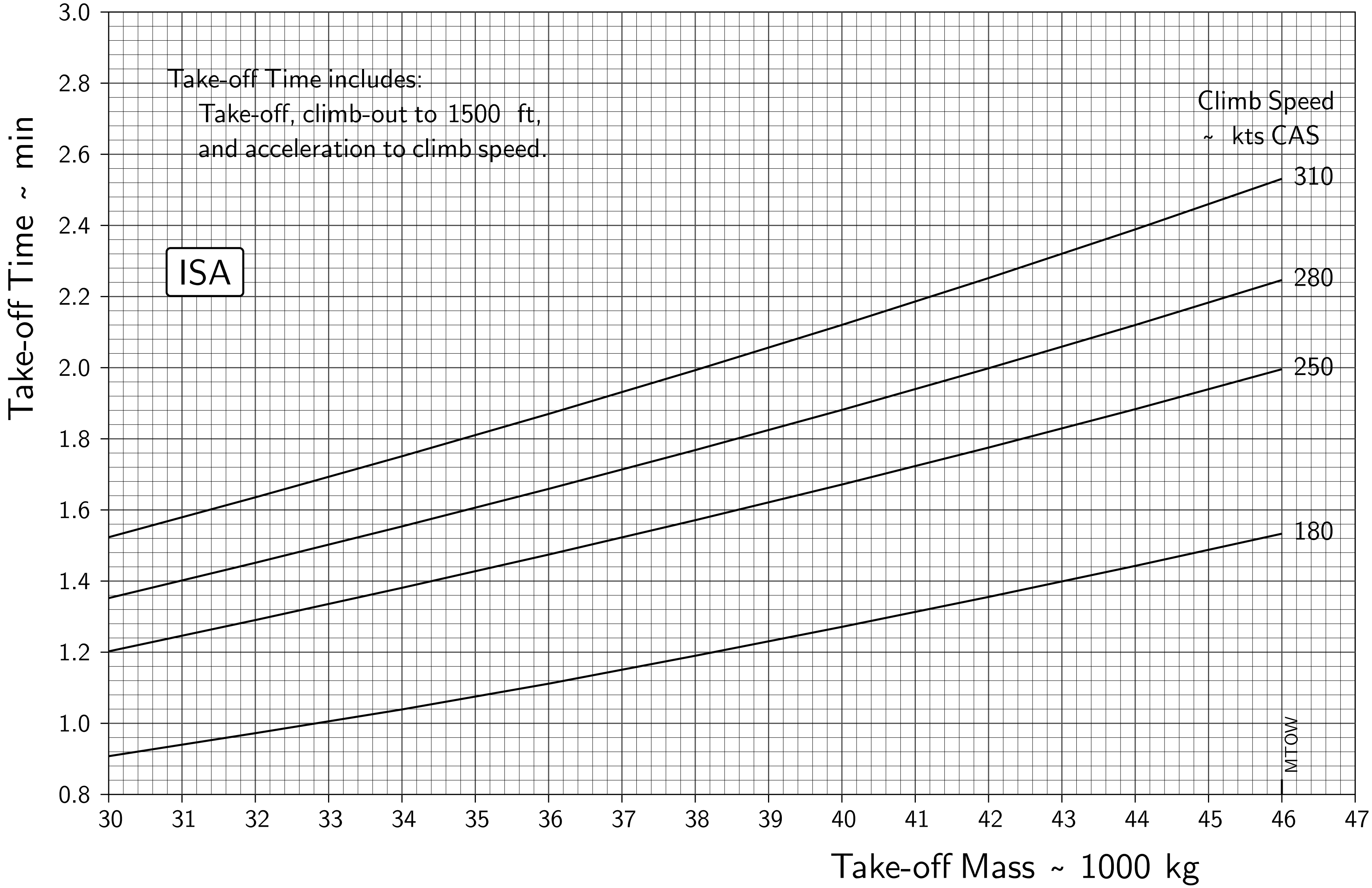

Figure 9.2: Take-off time at ISA.

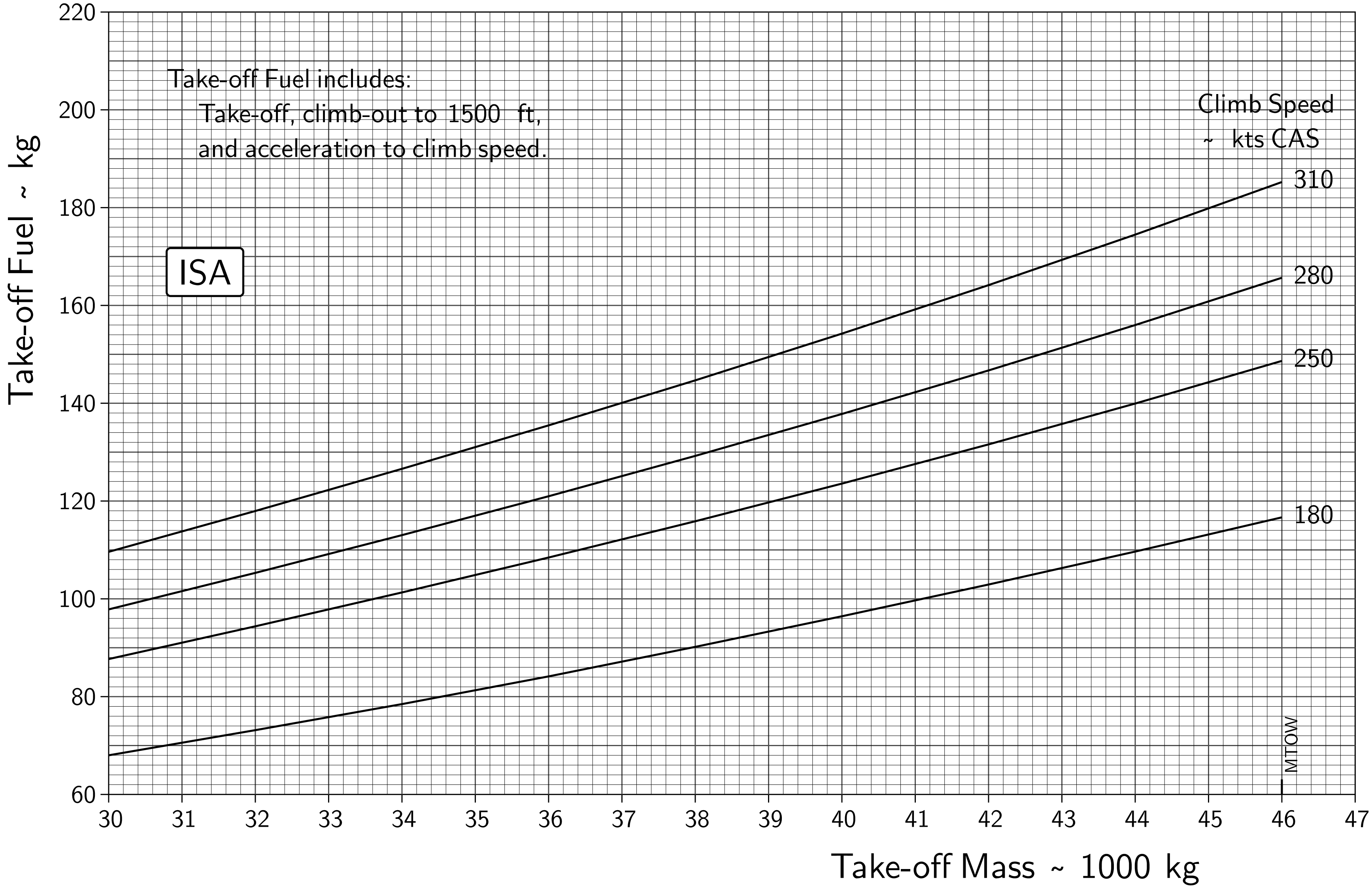

Figure 9.3: Take-off fuel at ISA.

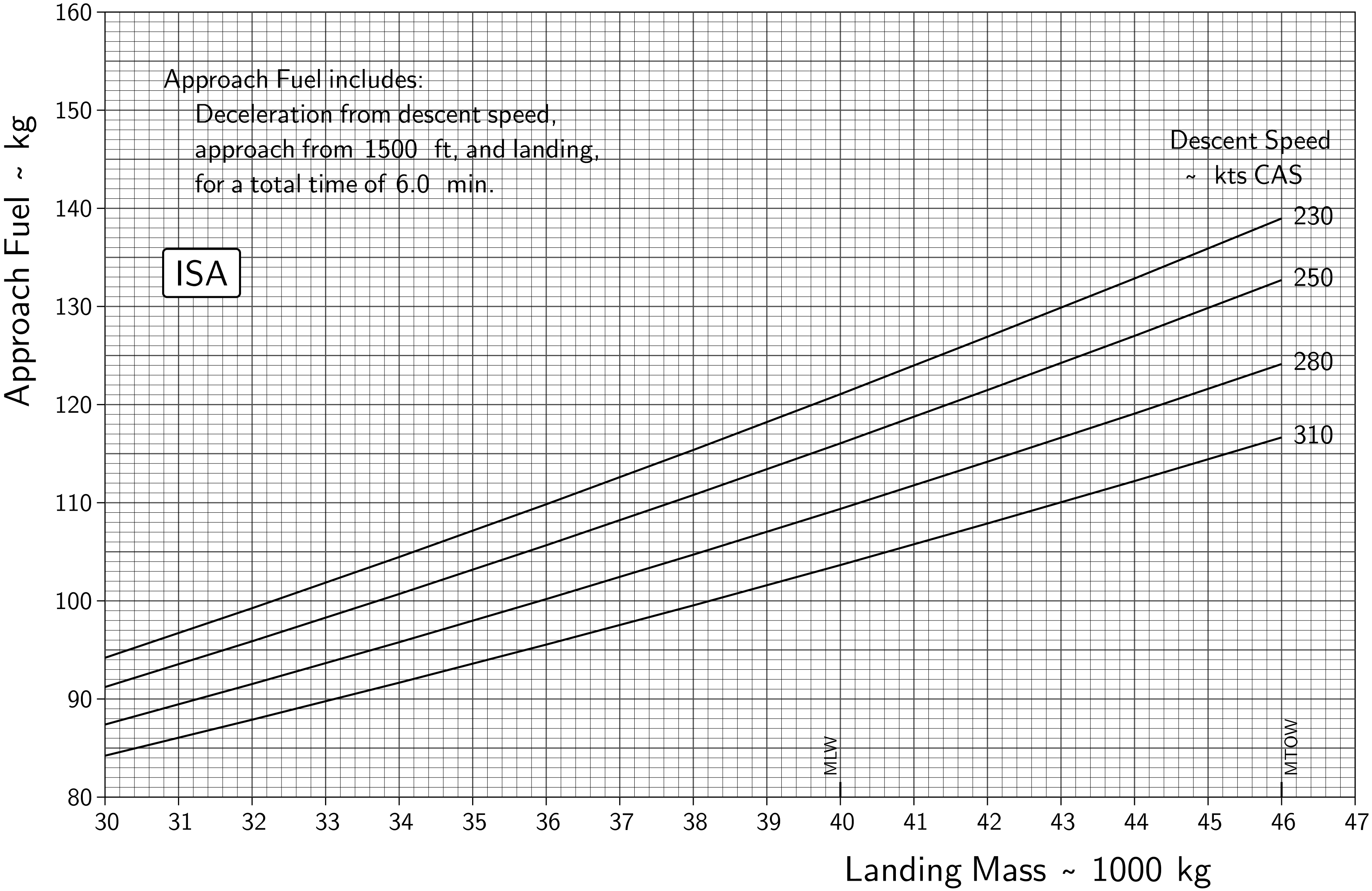

Figure 9.4: Approach fuel at ISA.

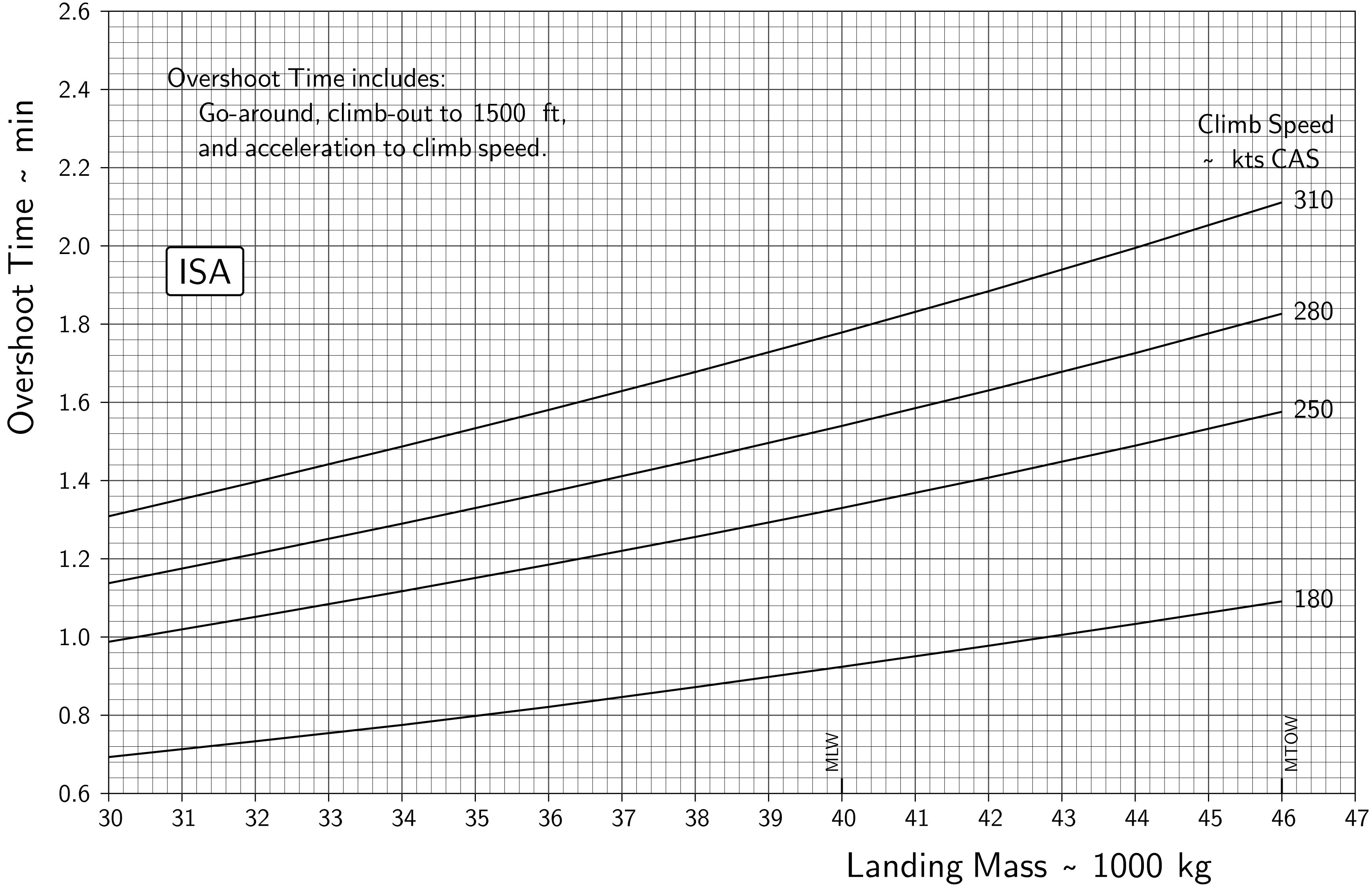

Figure 9.5: Overshoot time at ISA.

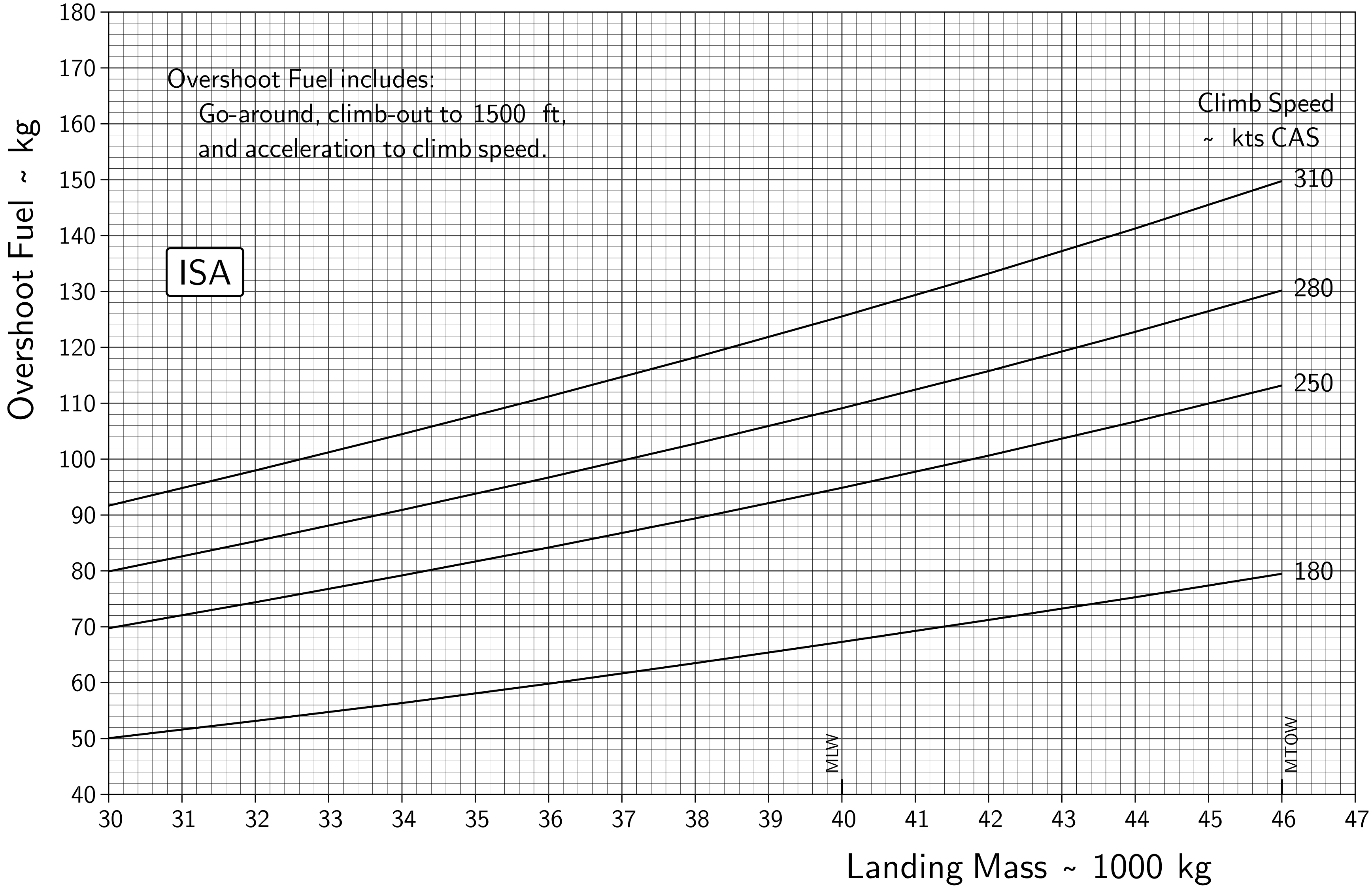

Figure 9.6: Overshoot fuel at ISA.

Chapter 10

Flight profile

Assumptions

ICAO Standard Flight Levels.
Operational speed restriction of 250 kts CAS below 10 000 ft.
Taxi-out 9.0 min, approach 6.0 min, and taxi-in 5.0 min.
No wind.
Zero-fuel mass 36 103 kg.
Reserves: 200 N.M. diversion, 45 min holding at 1 500 ft over alternate.

Figures

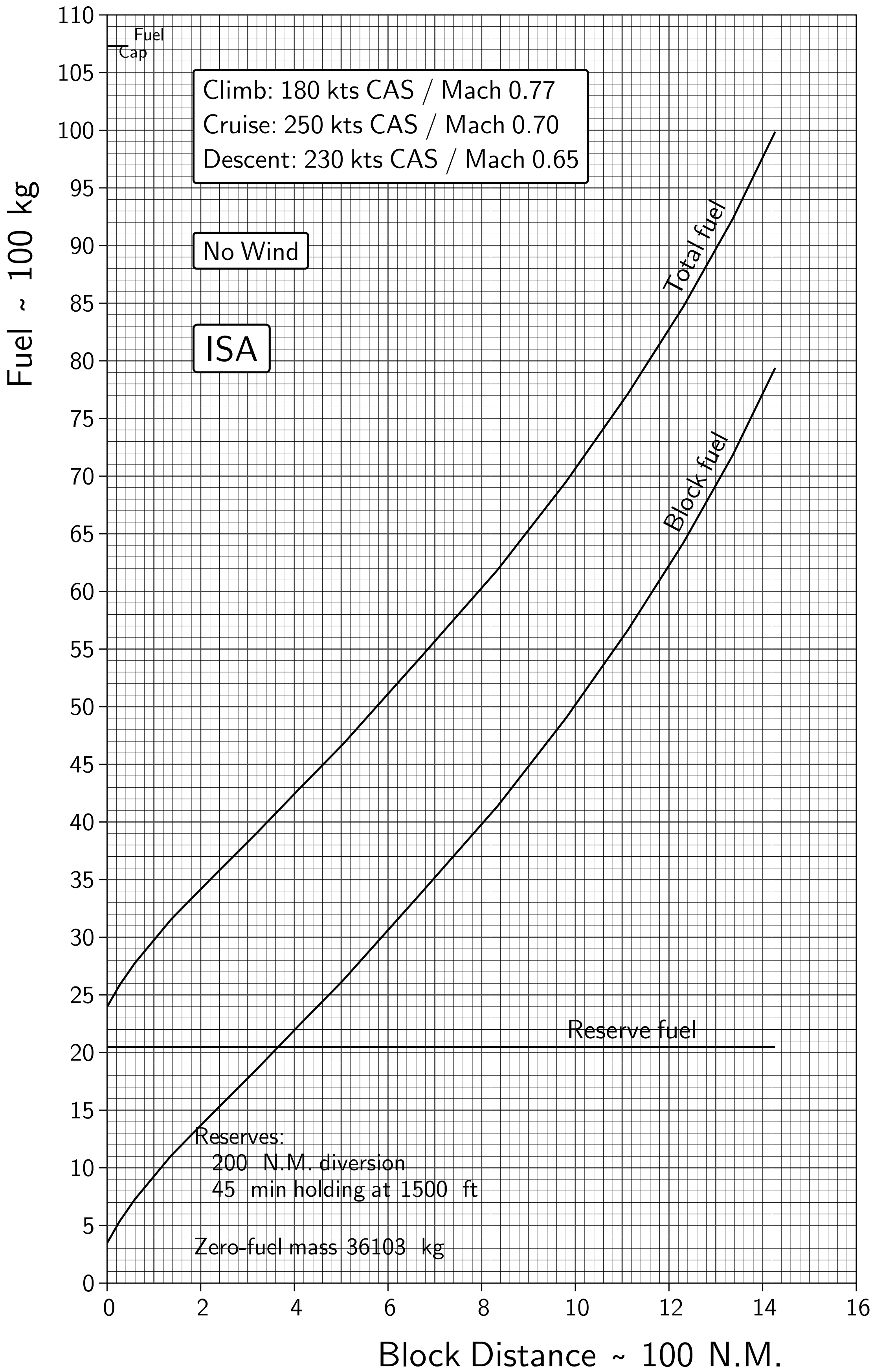

Figure 10.1: Fuel for climb at 180 kts CAS / Mach 0.77, cruise at 250 kts CAS / Mach 0.70, descent at 230 kts CAS / Mach 0.65 at ISA.

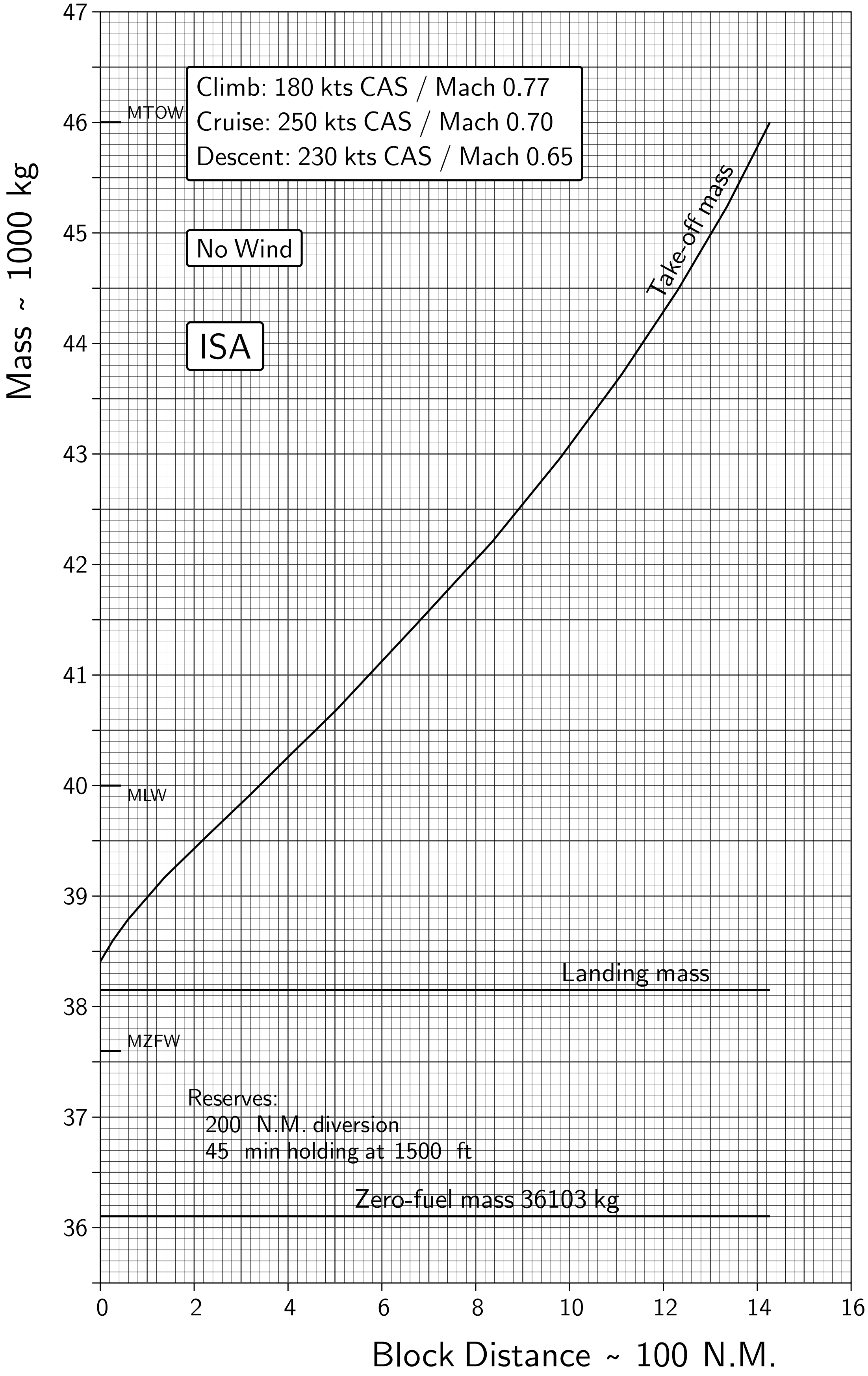

Figure 10.2: Mass for climb at 180 kts CAS / Mach 0.77, cruise at 250 kts CAS / Mach 0.70, descent at 230 kts CAS / Mach 0.65 at ISA.

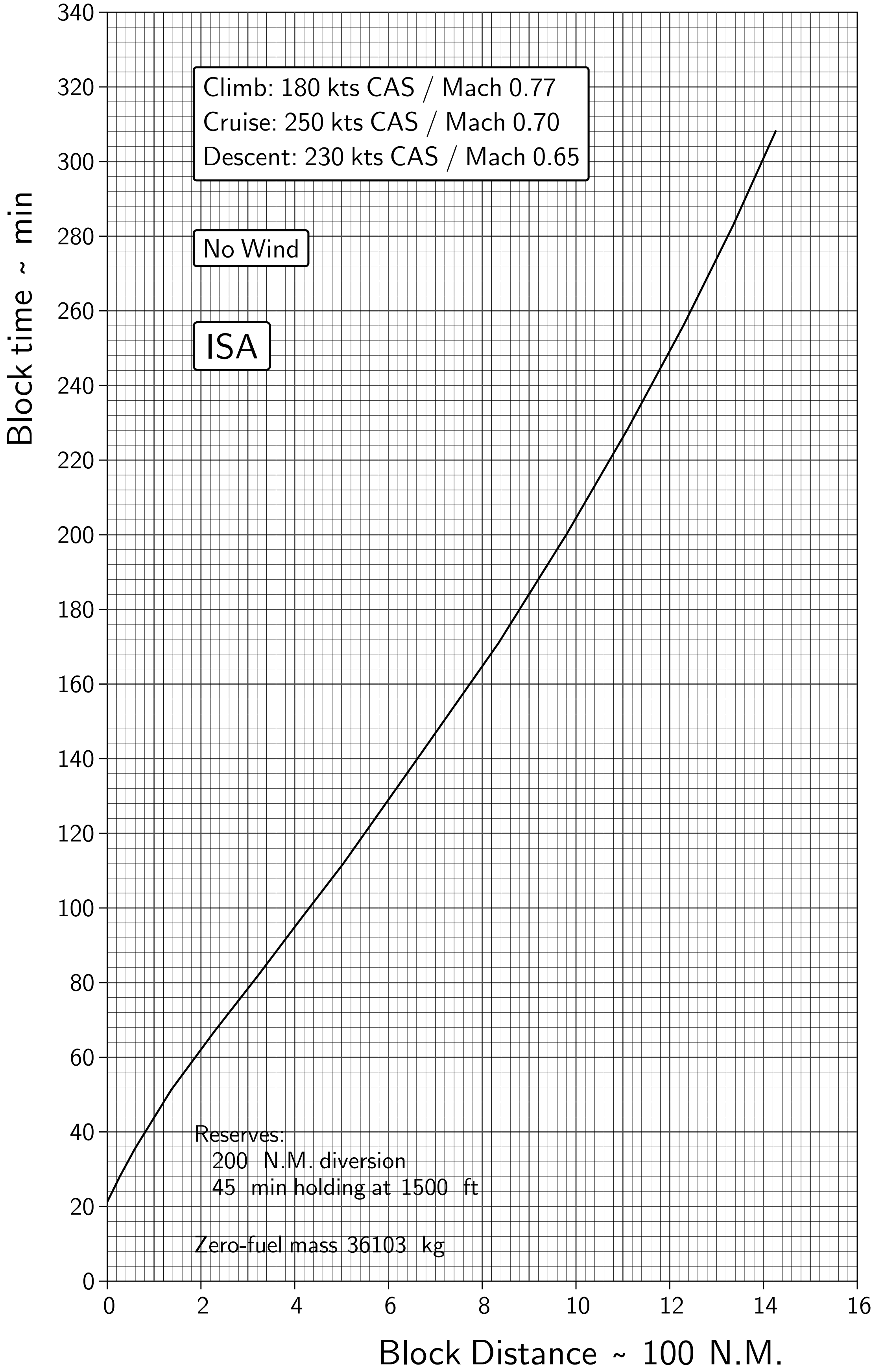

Figure 10.3: Block time for climb at 180 kts CAS / Mach 0.77, cruise at 250 kts CAS / Mach 0.70, descent at 230 kts CAS / Mach 0.65 at ISA.

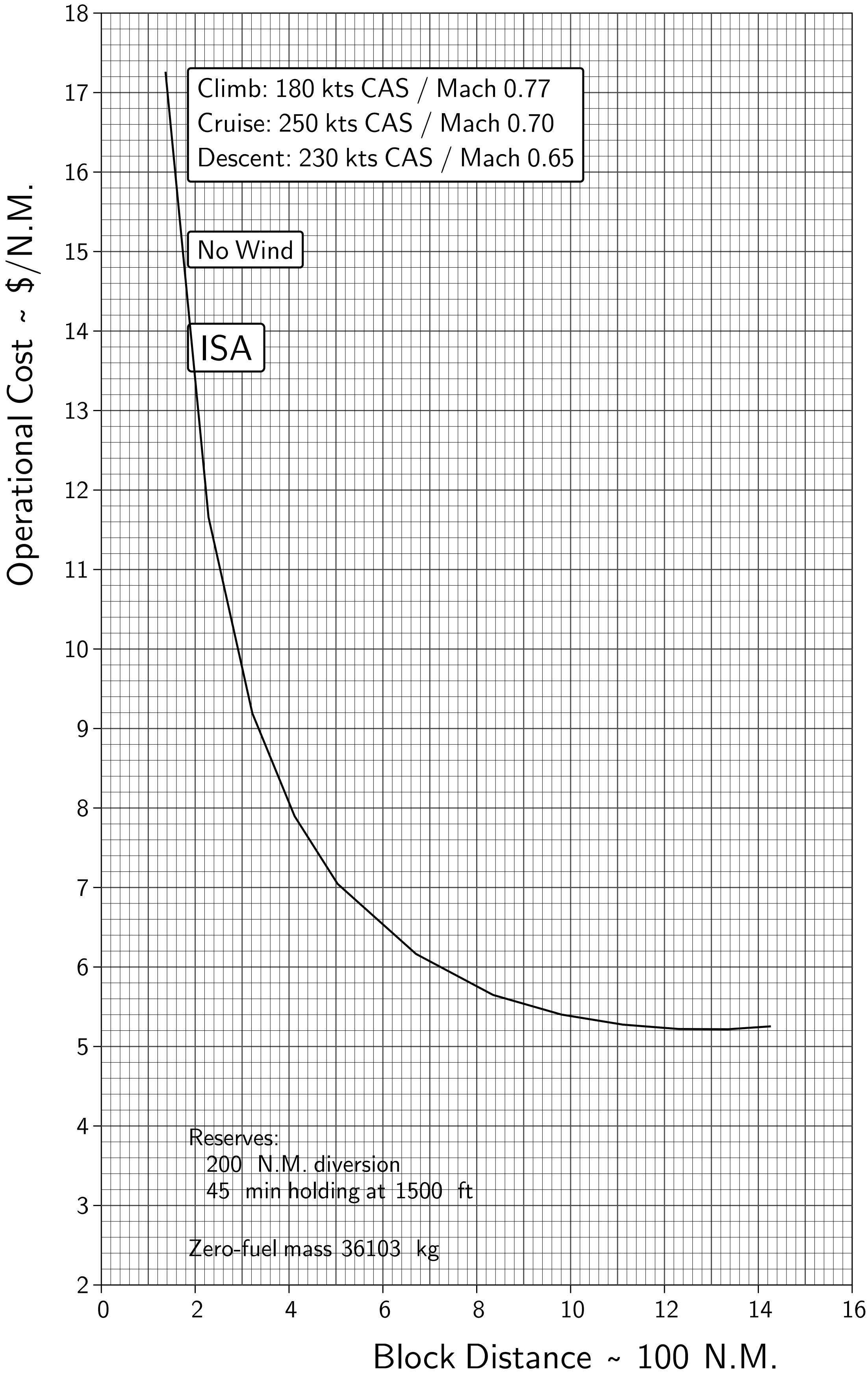

Figure 10.4: Cost/N.M. for climb at 180 kts CAS / Mach 0.77, cruise at 250 kts CAS / Mach 0.70, descent at 230 kts CAS / Mach 0.65 at ISA.

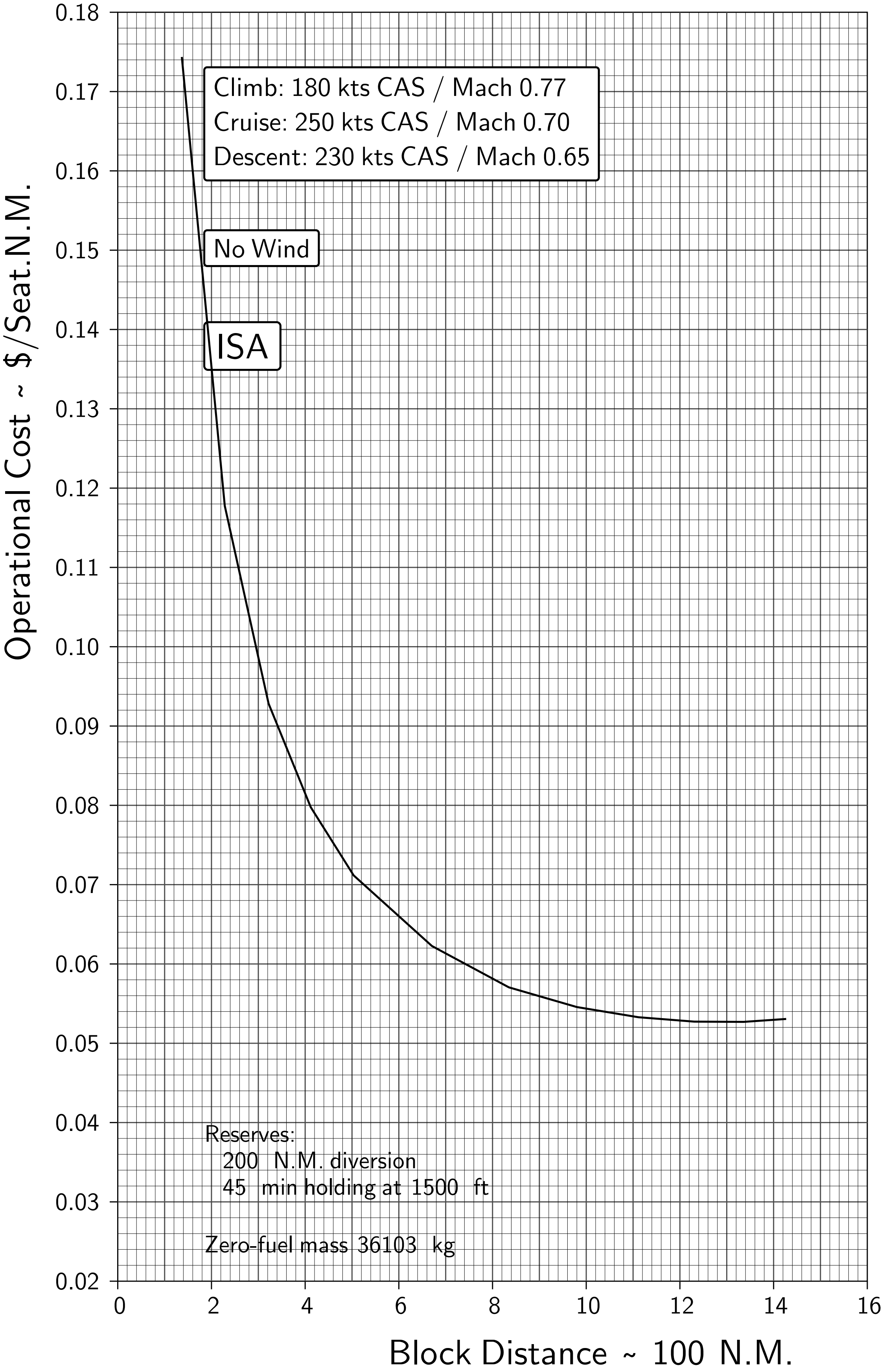

Figure 10.5: Cost/Seat.N.M. for climb at 180 kts CAS / Mach 0.77, cruise at 250 kts CAS / Mach 0.70, descent at 230 kts CAS / Mach 0.65 at ISA.

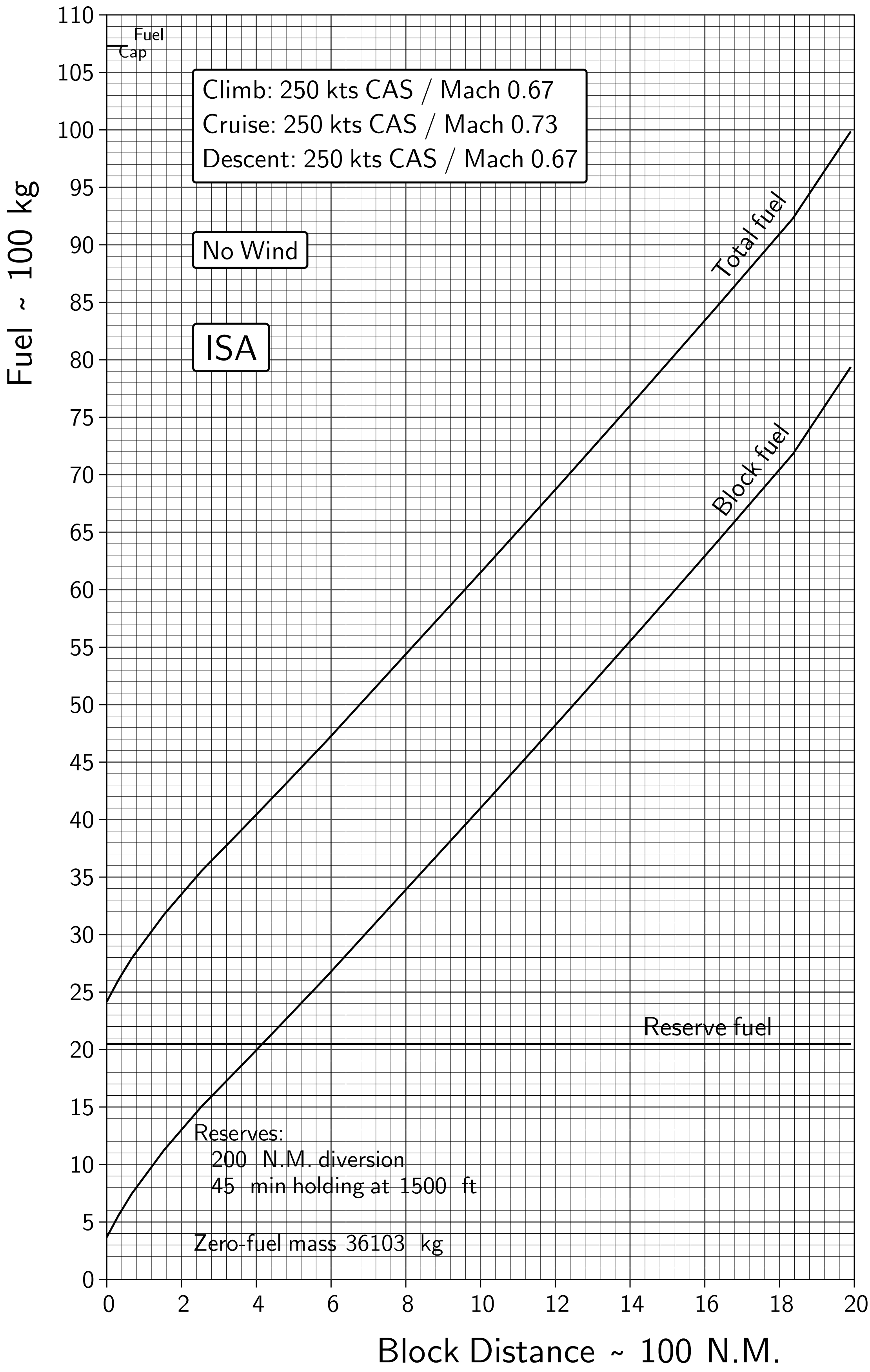

Figure 10.6: Fuel for climb at 250 kts CAS / Mach 0.67, cruise at 250 kts CAS / Mach 0.73, descent at 250 kts CAS / Mach 0.67 at ISA.

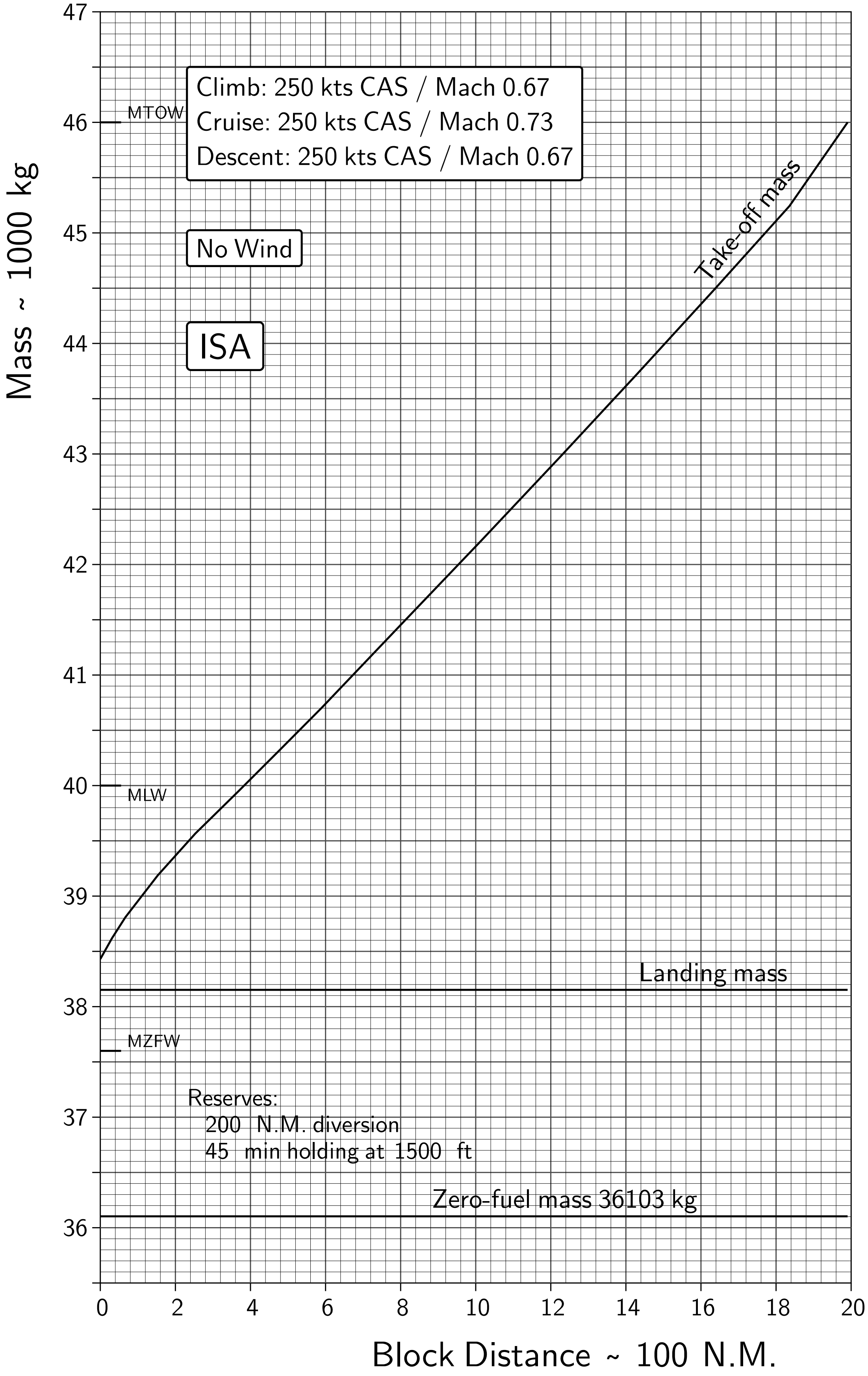

Figure 10.7: Mass for climb at 250 kts CAS / Mach 0.67, cruise at 250 kts CAS / Mach 0.73, descent at 250 kts CAS / Mach 0.67 at ISA.

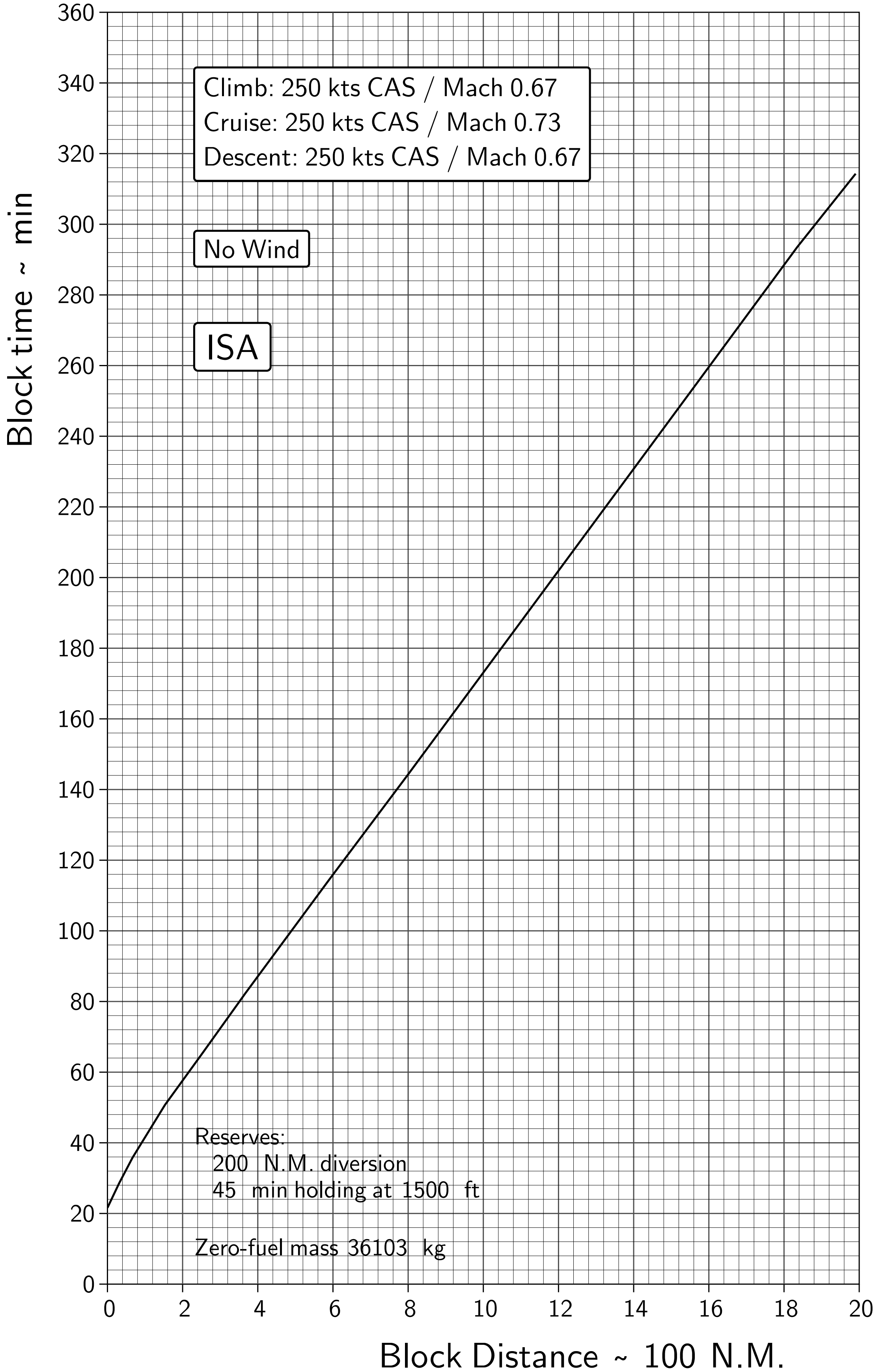

Figure 10.8: Block time for climb at 250 kts CAS / Mach 0.67, cruise at 250 kts CAS / Mach 0.73, descent at 250 kts CAS / Mach 0.67 at ISA.

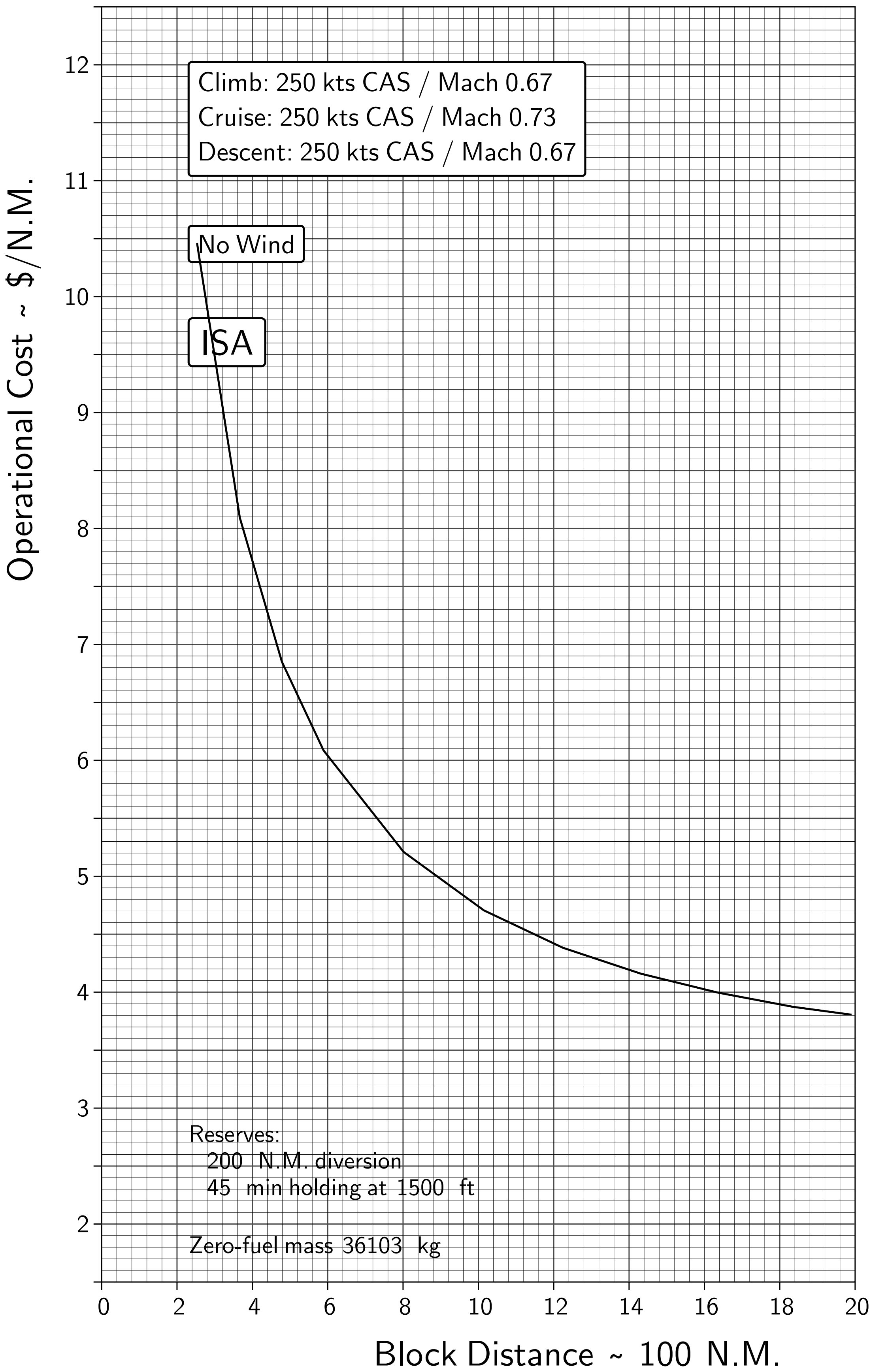

Figure 10.9: Cost/N.M. for climb at 250 kts CAS / Mach 0.67, cruise at 250 kts CAS / Mach 0.73, descent at 250 kts CAS / Mach 0.67 at ISA.

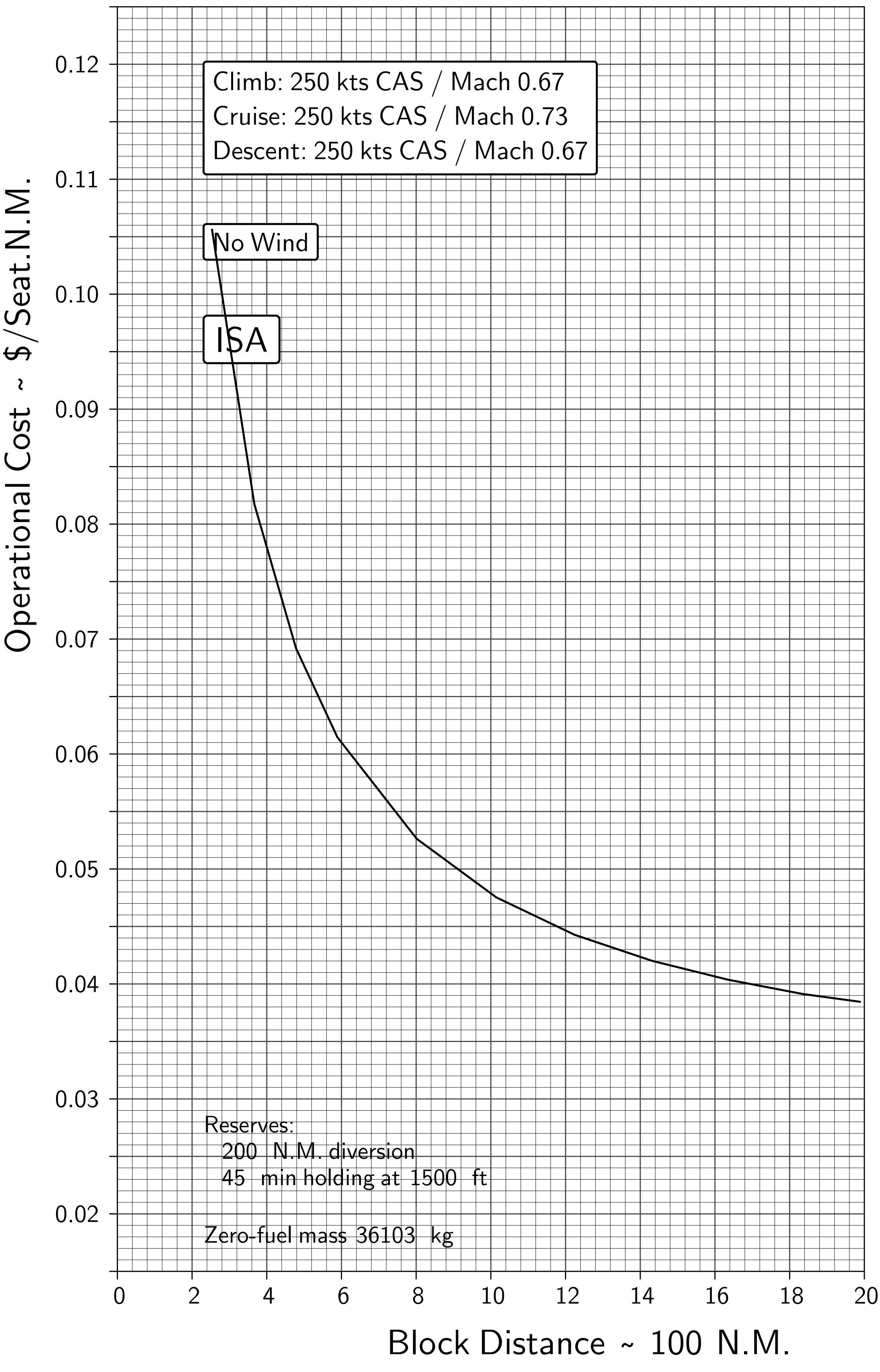

Figure 10.10: Cost/Seat.N.M. for climb at 250 kts CAS / Mach 0.67, cruise at 250 kts CAS / Mach 0.73, descent at 250 kts CAS / Mach 0.67 at ISA.

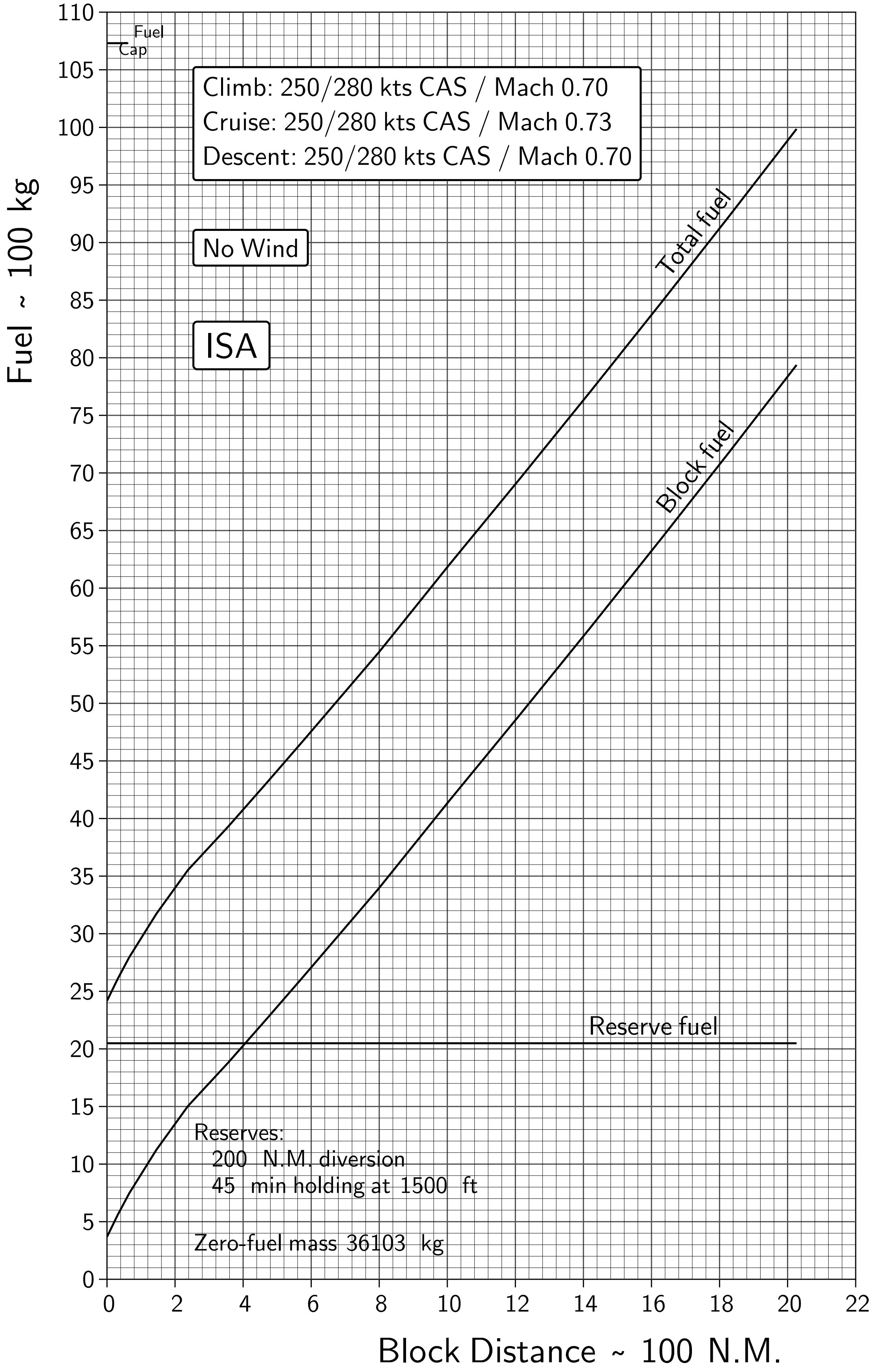

Figure 10.11: Fuel for climb at 250/280 kts CAS / Mach 0.70, cruise at 250/280 kts CAS / Mach 0.73, descent at 250/280 kts CAS / Mach 0.70 at ISA.

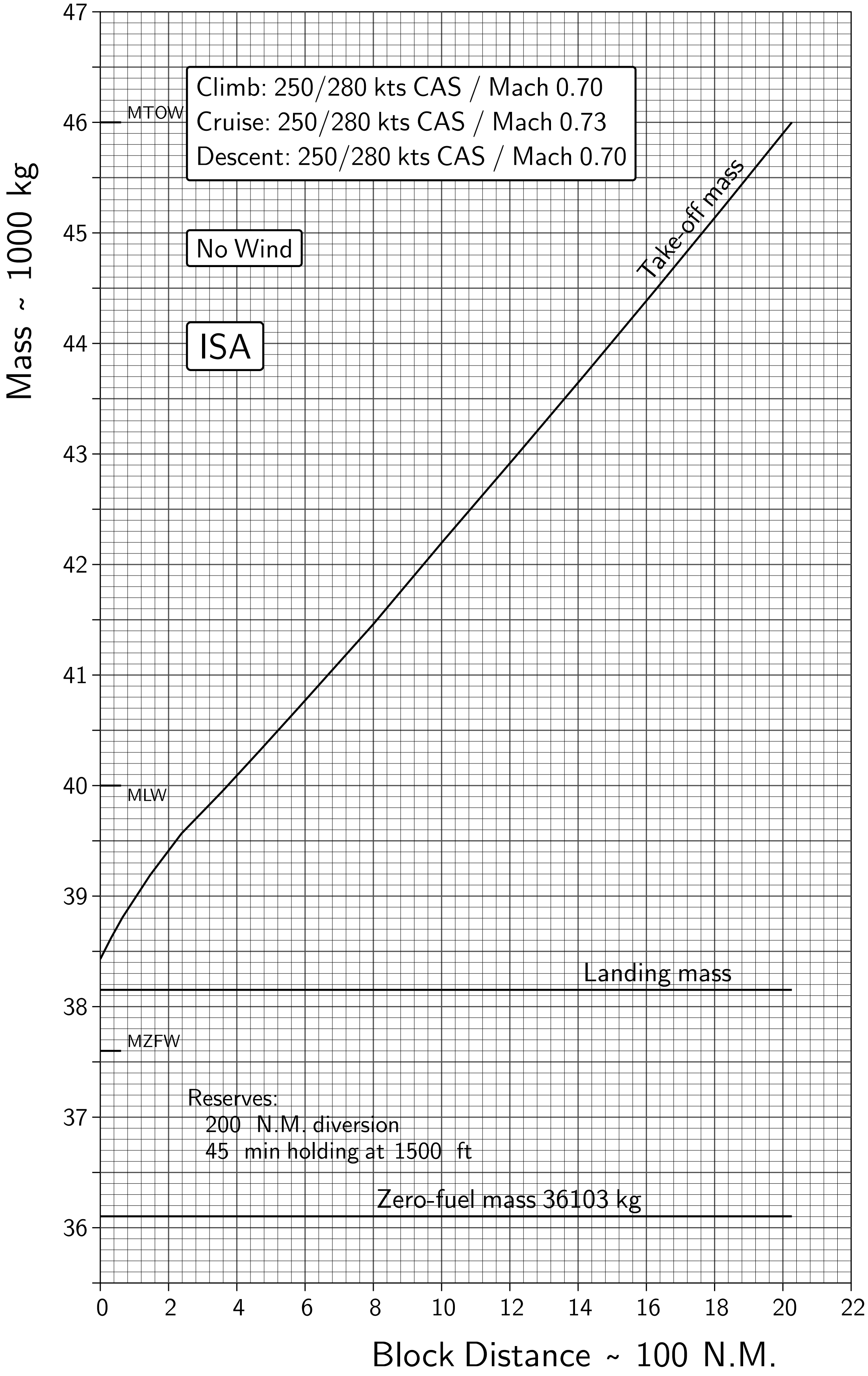

Figure 10.12: Mass for climb at 250/280 kts CAS / Mach 0.70, cruise at 250/280 kts CAS / Mach 0.73, descent at 250/280 kts CAS / Mach 0.70 at ISA.

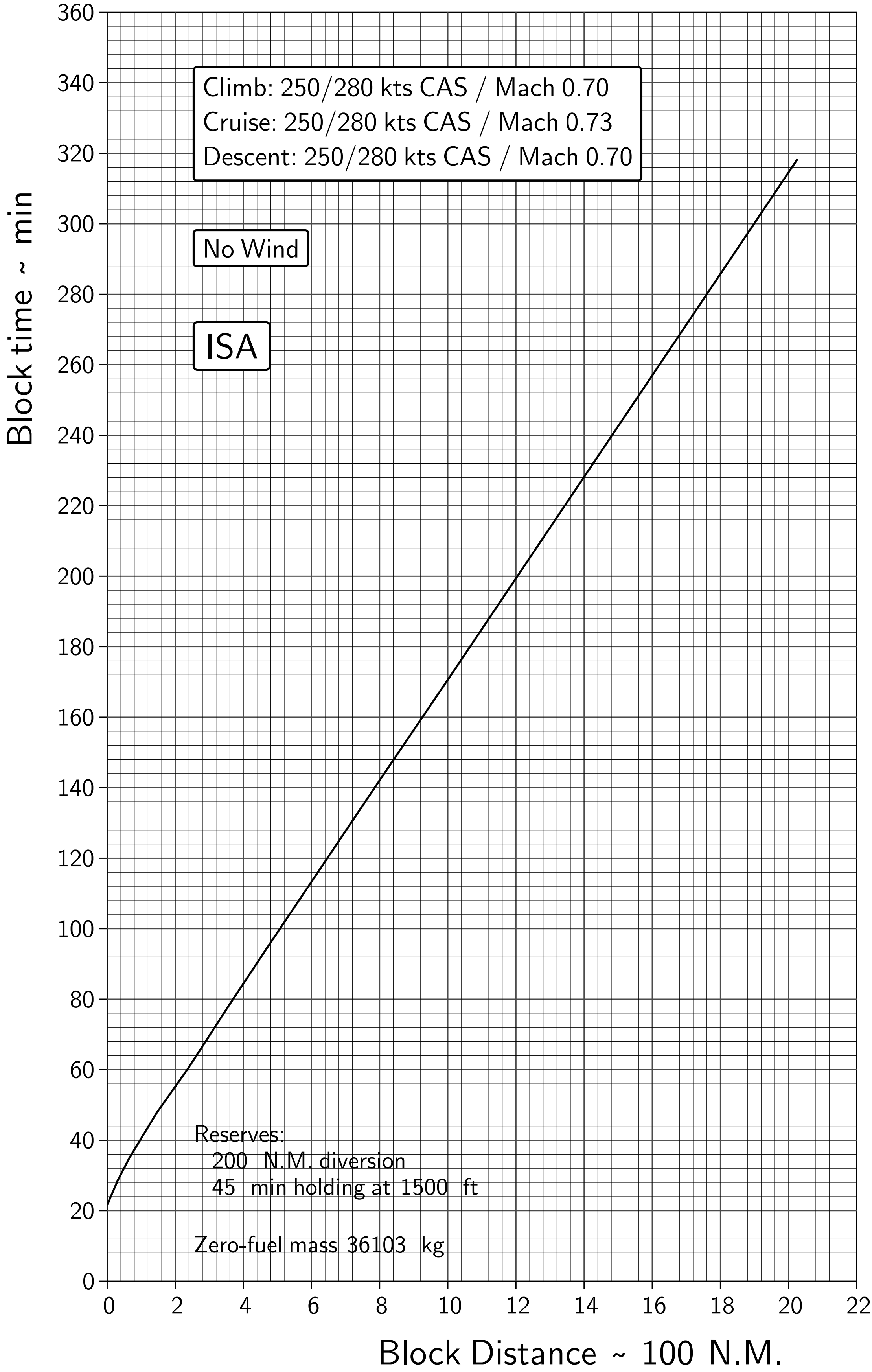

Figure 10.13: Block time for climb at 250/280 kts CAS / Mach 0.70, cruise at 250/280 kts CAS / Mach 0.73, descent at 250/280 kts CAS / Mach 0.70 at ISA.

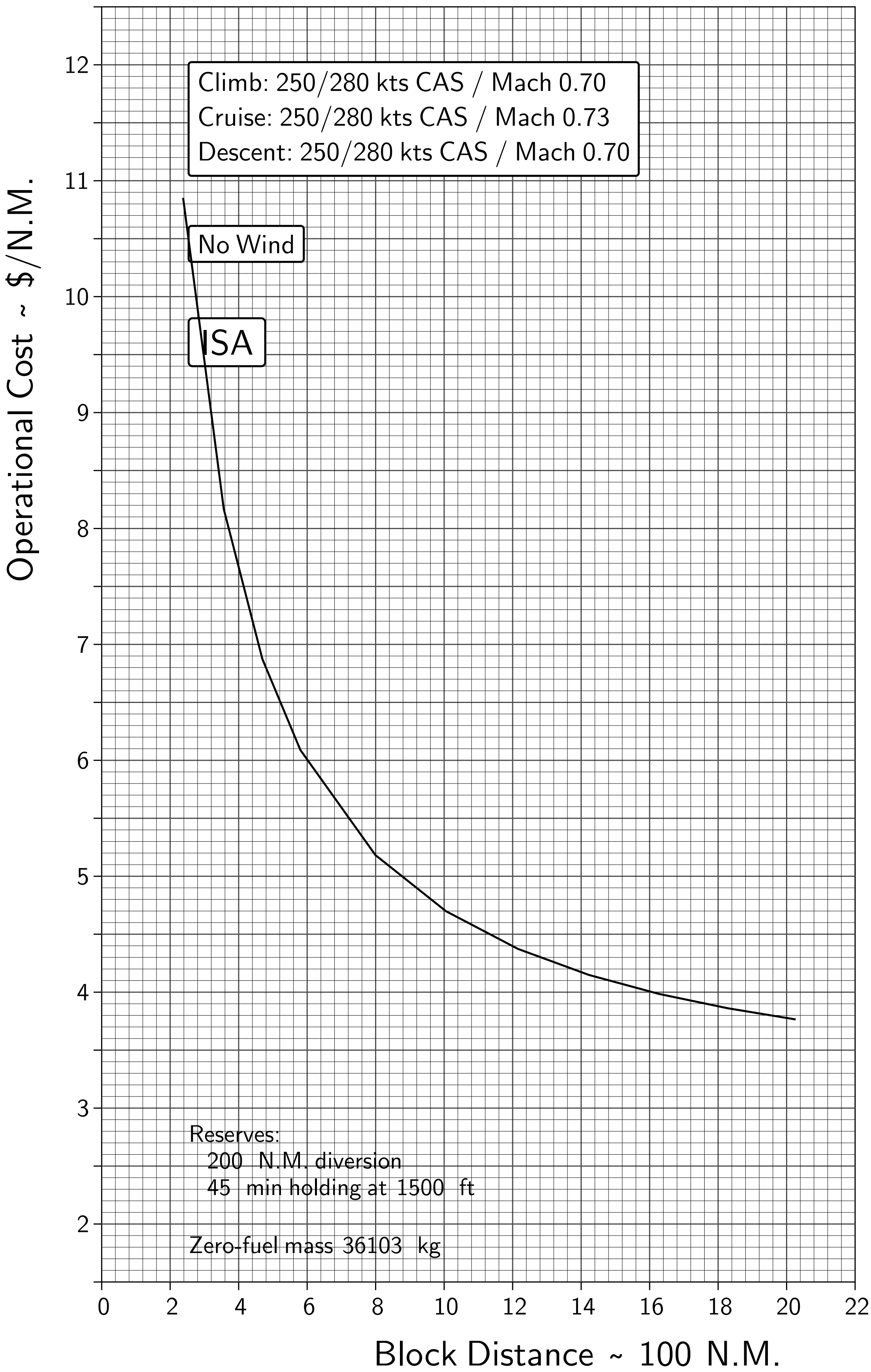

Figure 10.14: Cost/N.M. for climb at 250/280 kts CAS / Mach 0.70, cruise at 250/280 kts CAS / Mach 0.73, descent at 250/280 kts CAS / Mach 0.70 at ISA.

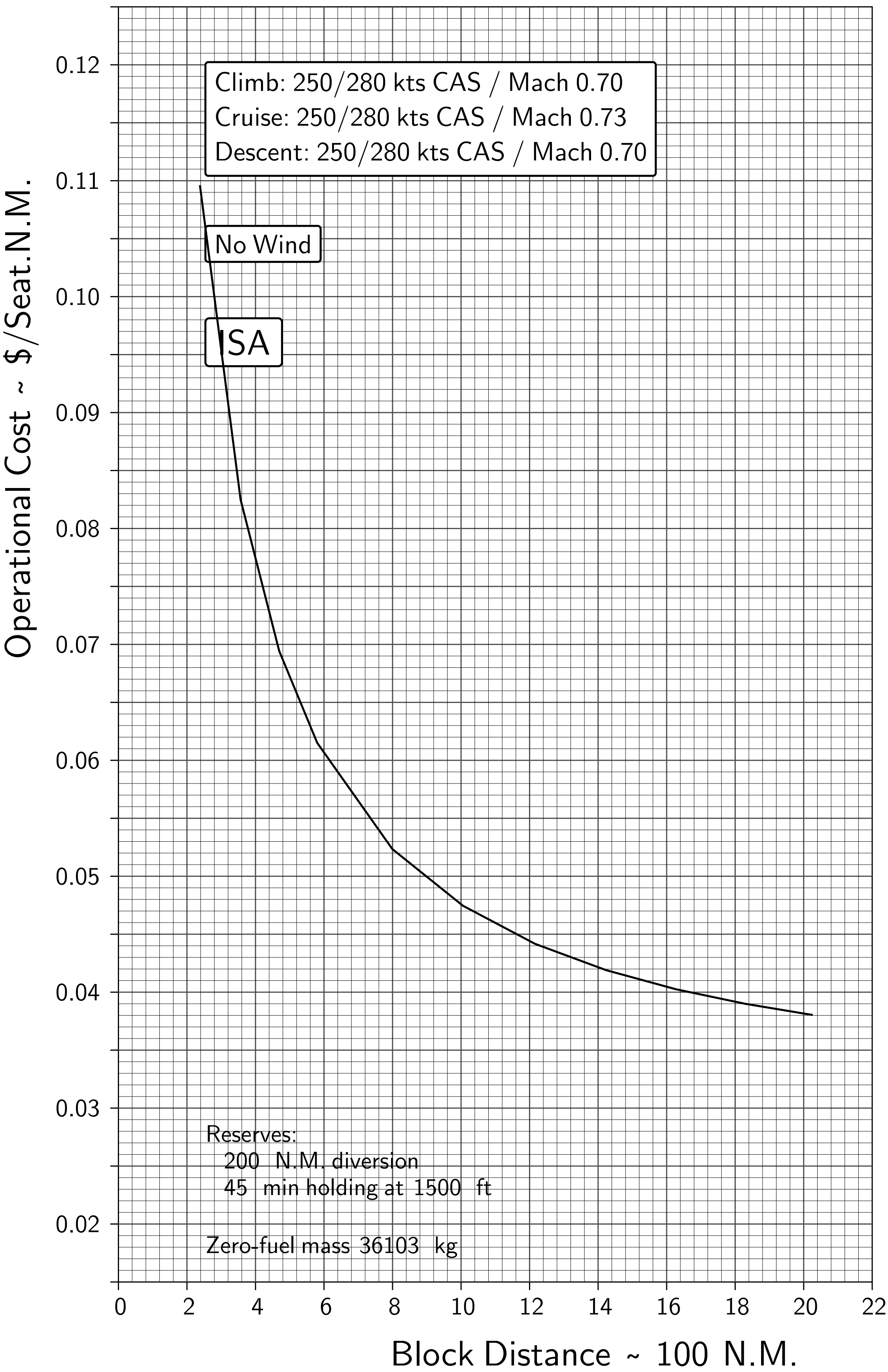

Figure 10.15: Cost/Seat.N.M. for climb at 250/280 kts CAS / Mach 0.70, cruise at 250/280 kts CAS / Mach 0.73, descent at 250/280 kts CAS / Mach 0.70 at ISA.

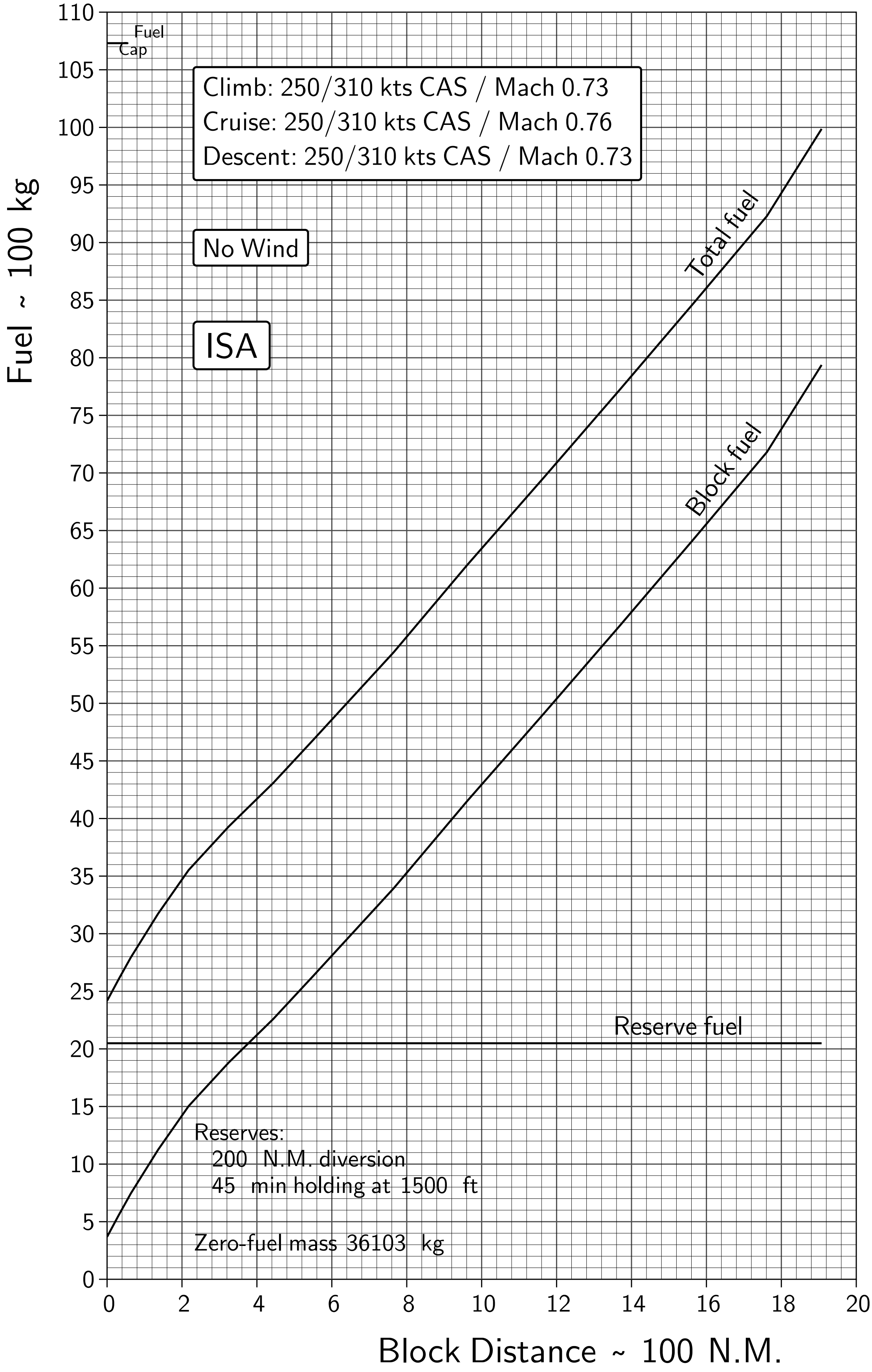

Figure 10.16: Fuel for climb at 250/310 kts CAS / Mach 0.73, cruise at 250/310 kts CAS / Mach 0.76, descent at 250/310 kts CAS / Mach 0.73 at ISA.

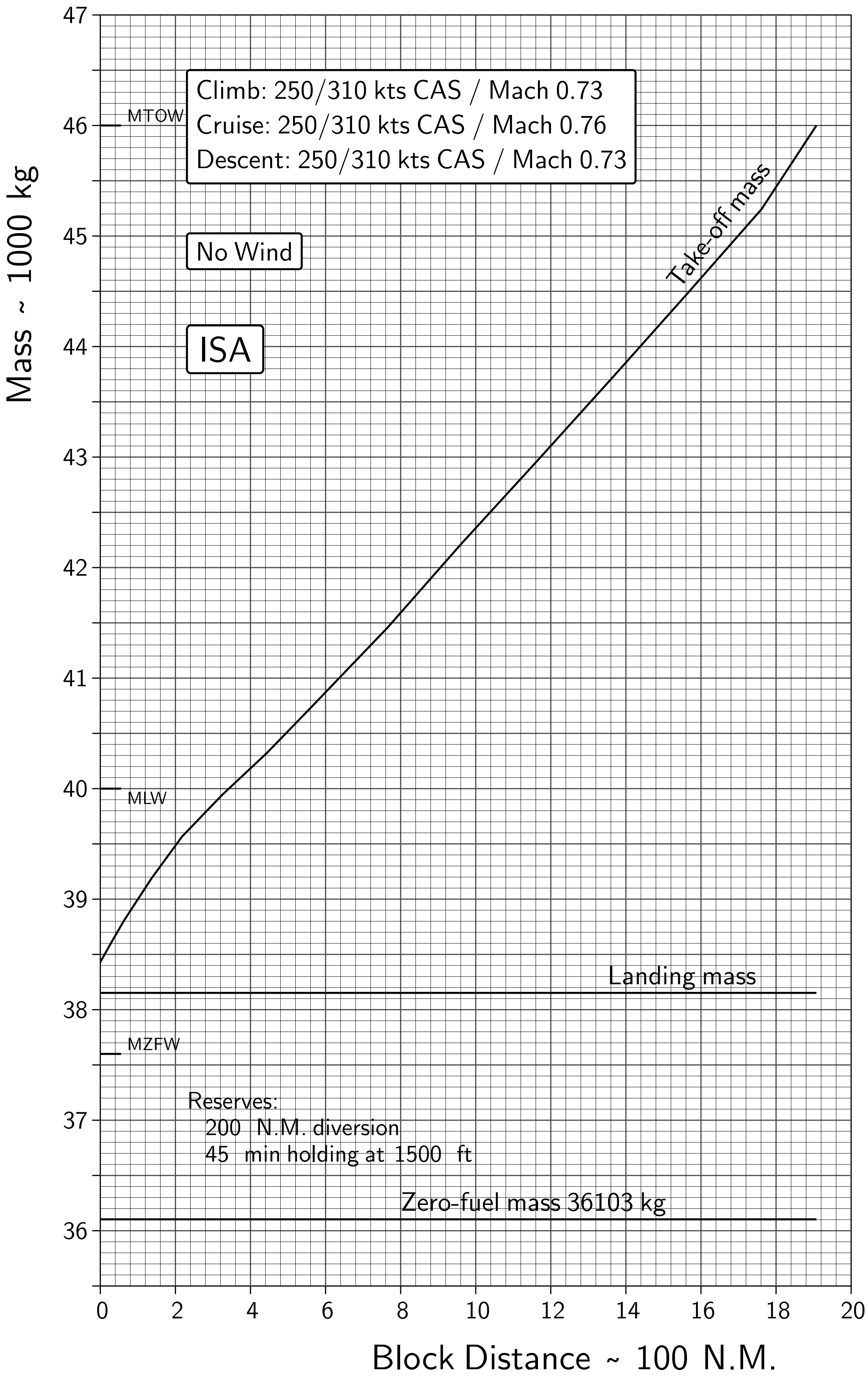

Figure 10.17: Mass for climb at 250/310 kts CAS / Mach 0.73, cruise at 250/310 kts CAS / Mach 0.76, descent at 250/310 kts CAS / Mach 0.73 at ISA.

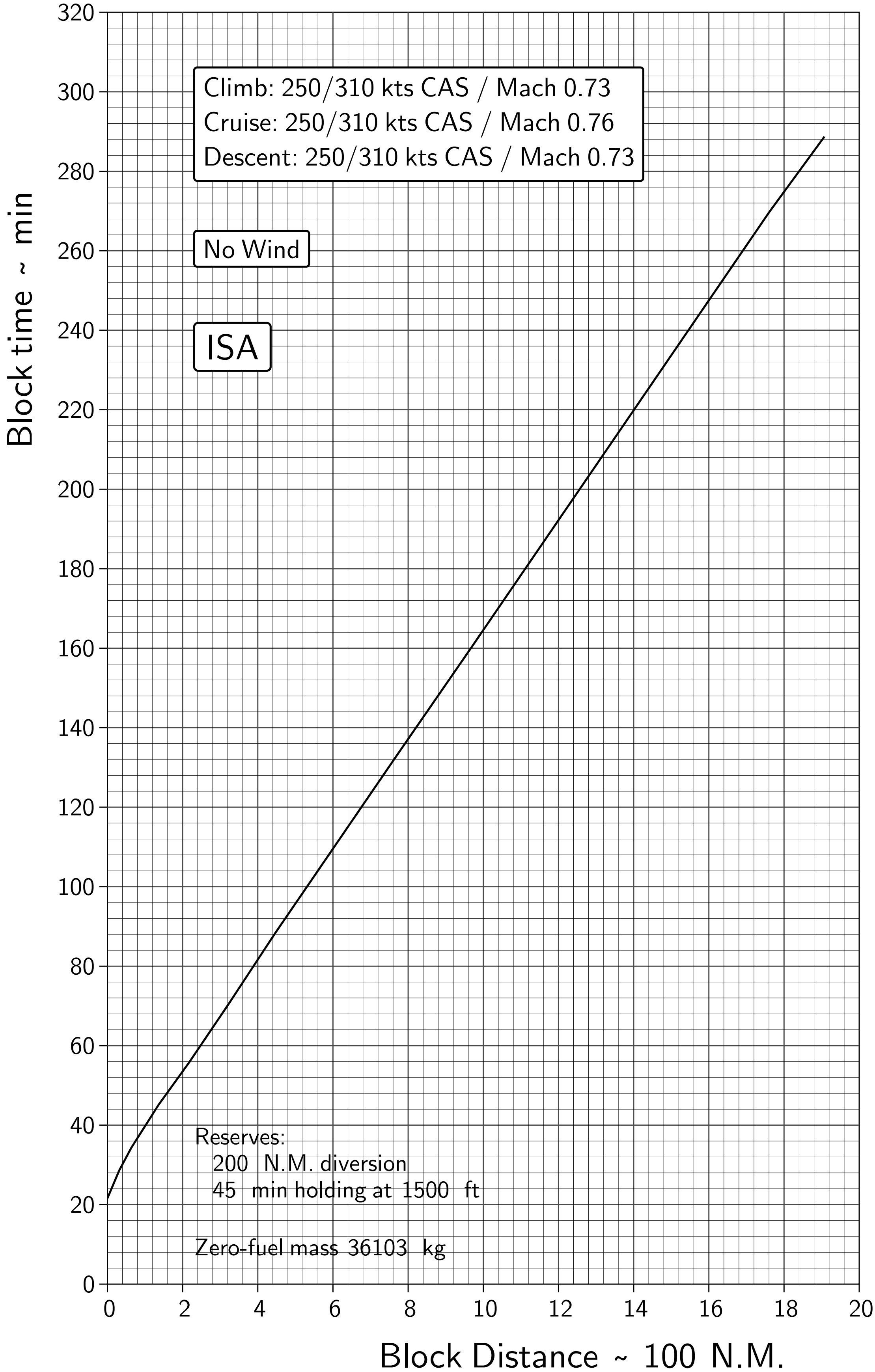

Figure 10.18: Block time for climb at 250/310 kts CAS / Mach 0.73, cruise at 250/310 kts CAS / Mach 0.76, descent at 250/310 kts CAS / Mach 0.73 at ISA.

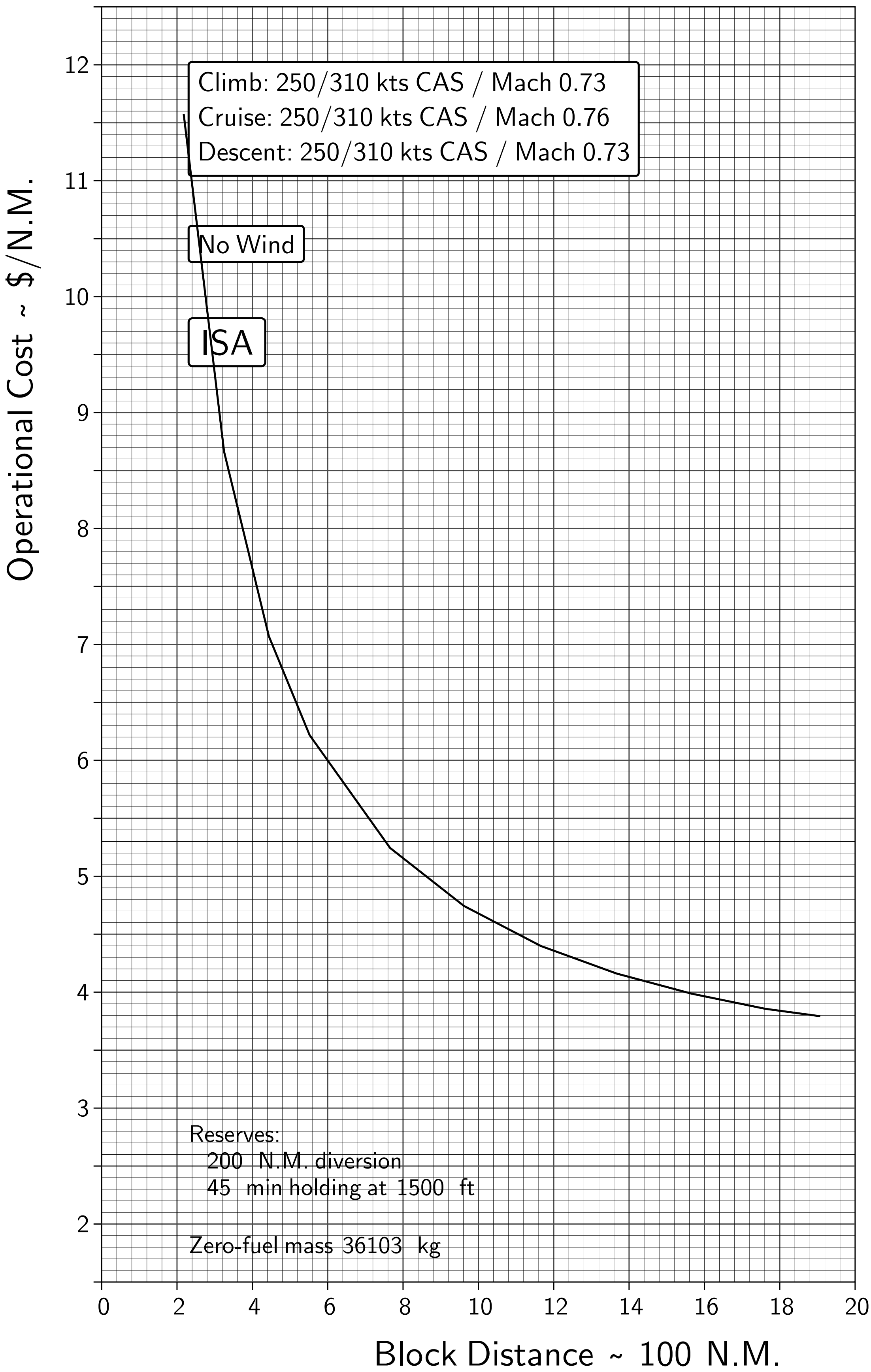

Figure 10.19: Cost/N.M. for climb at 250/310 kts **CAS** / Mach 0.73, cruise at 250/310 kts **CAS** / Mach 0.76, descent at 250/310 kts **CAS** / Mach 0.73 at ISA.

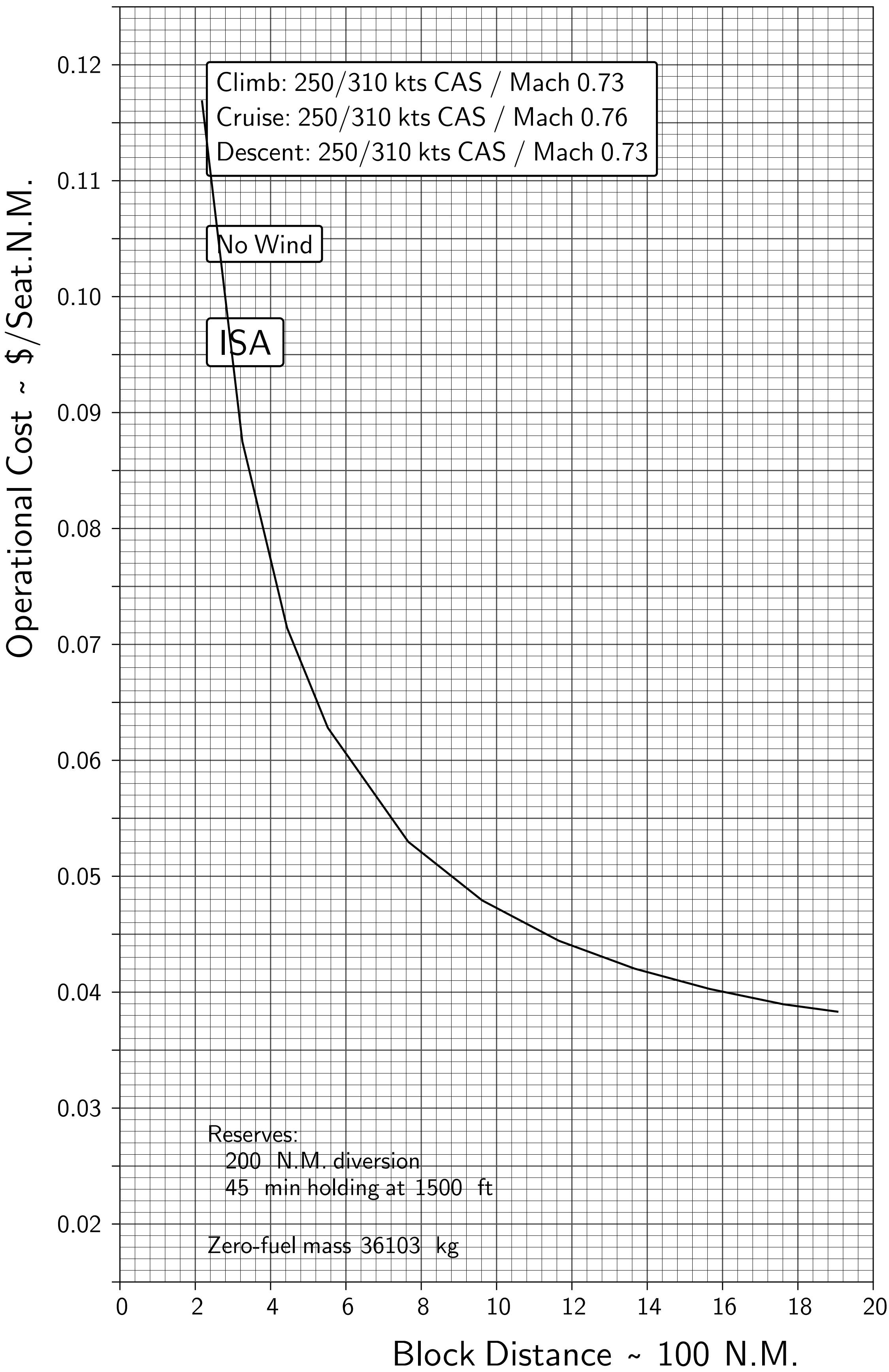

Figure 10.20: Cost/Seat.N.M. for climb at 250/310 kts CAS / Mach 0.73, cruise at 250/310 kts CAS / Mach 0.76, descent at 250/310 kts CAS / Mach 0.73 at ISA.

Chapter 11

Payload-range

Assumptions

ICAO Standard Flight Levels.
Operational speed restriction of 250 kts CAS below 10 000 ft.
Taxi-out 9.0 min, approach 6.0 min, and taxi-in 5.0 min.
No wind.
Operating empty mass 26 500 kg.
Reserves: 200 N.M. diversion, 45 min holding at 1 500 ft over alternate.

Figures

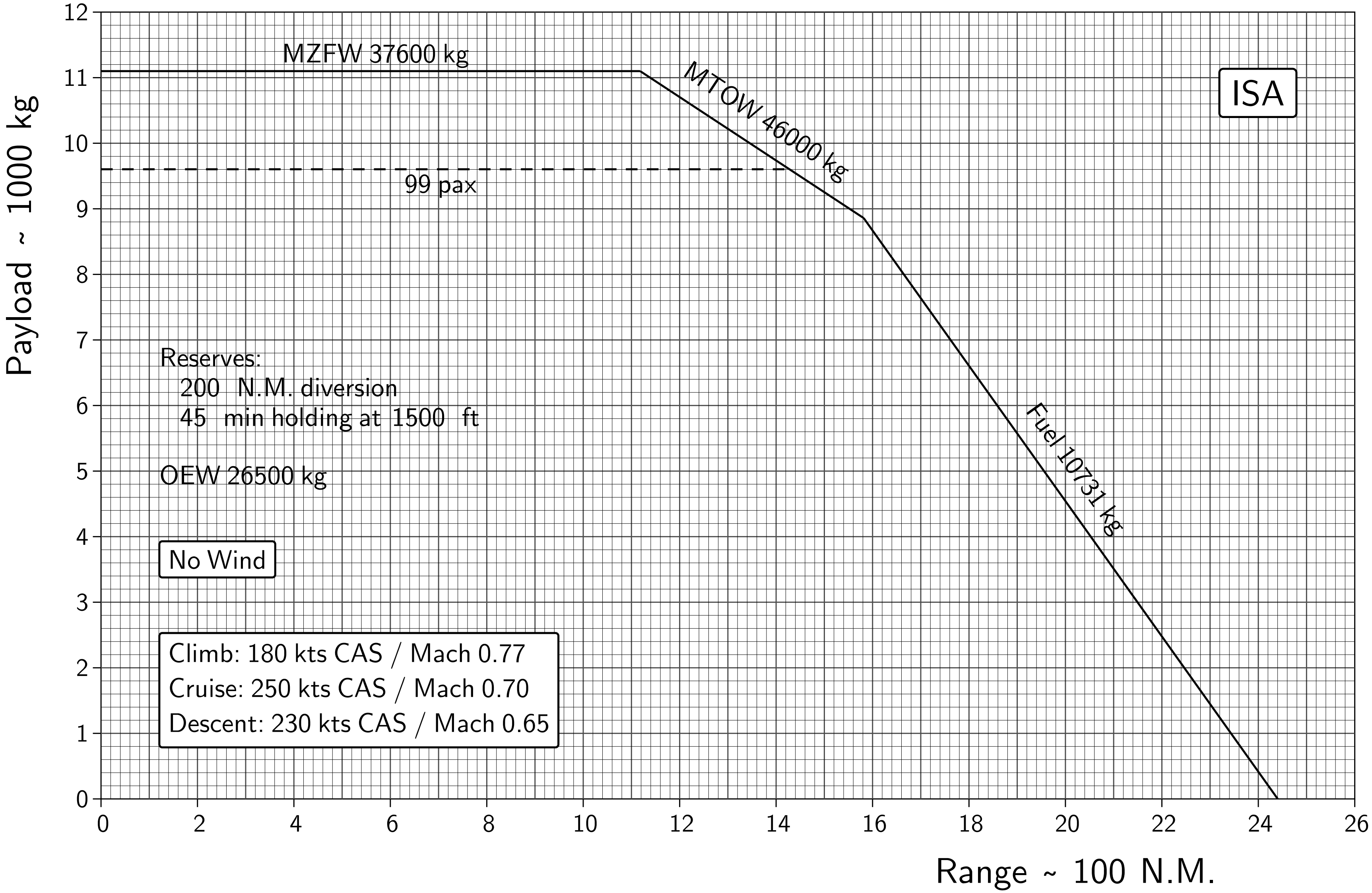

Figure 11.1: Payload-range for climb at 180 kts CAS / Mach 0.77, cruise at 250 kts CAS / Mach 0.70, descent at 230 kts CAS / Mach 0.65 at ISA.

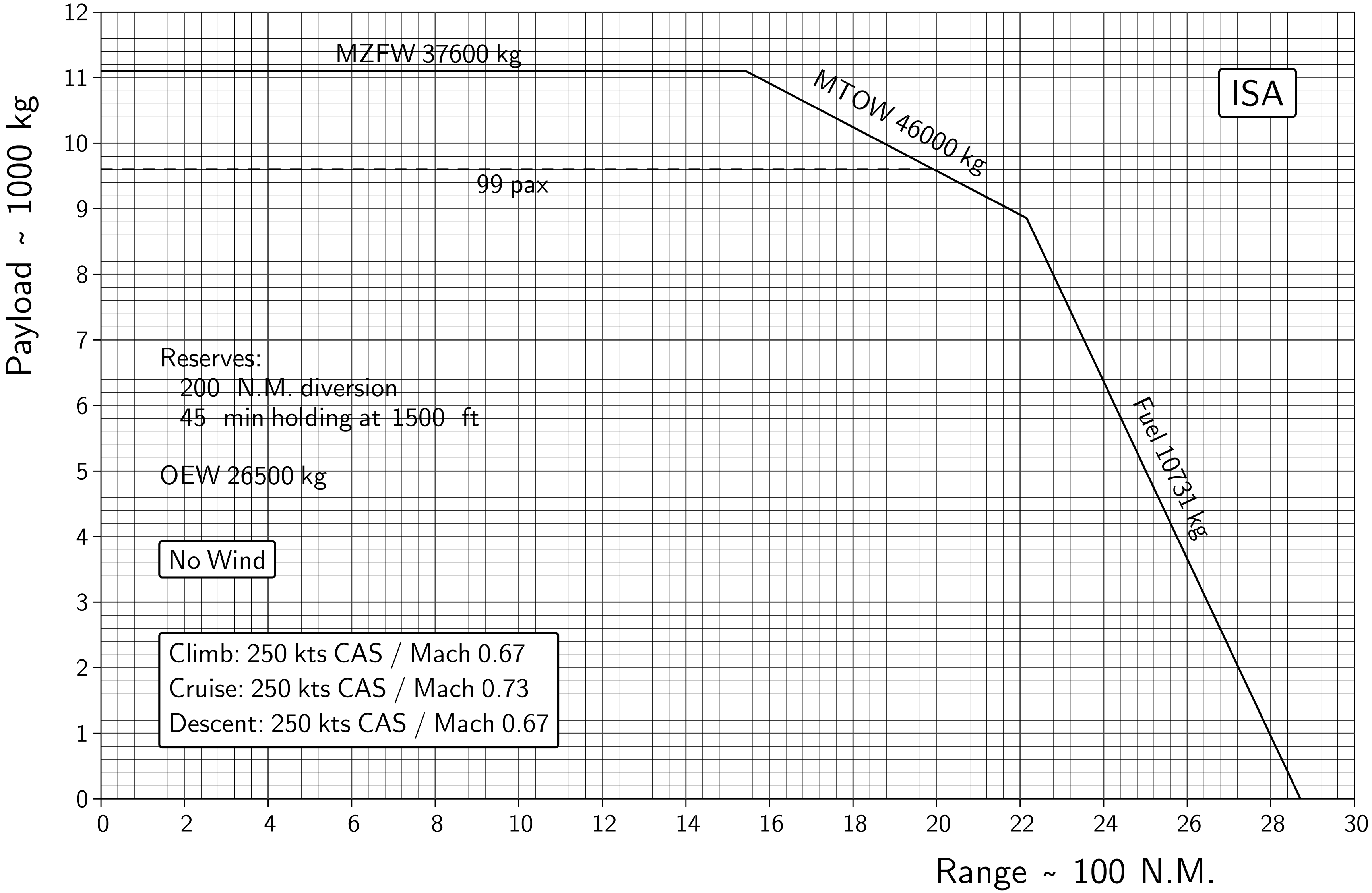

Figure 11.2: Payload-range for climb at 250 kts CAS / Mach 0.67, cruise at 250 kts CAS / Mach 0.73, descent at 250 kts CAS / Mach 0.67 at ISA.

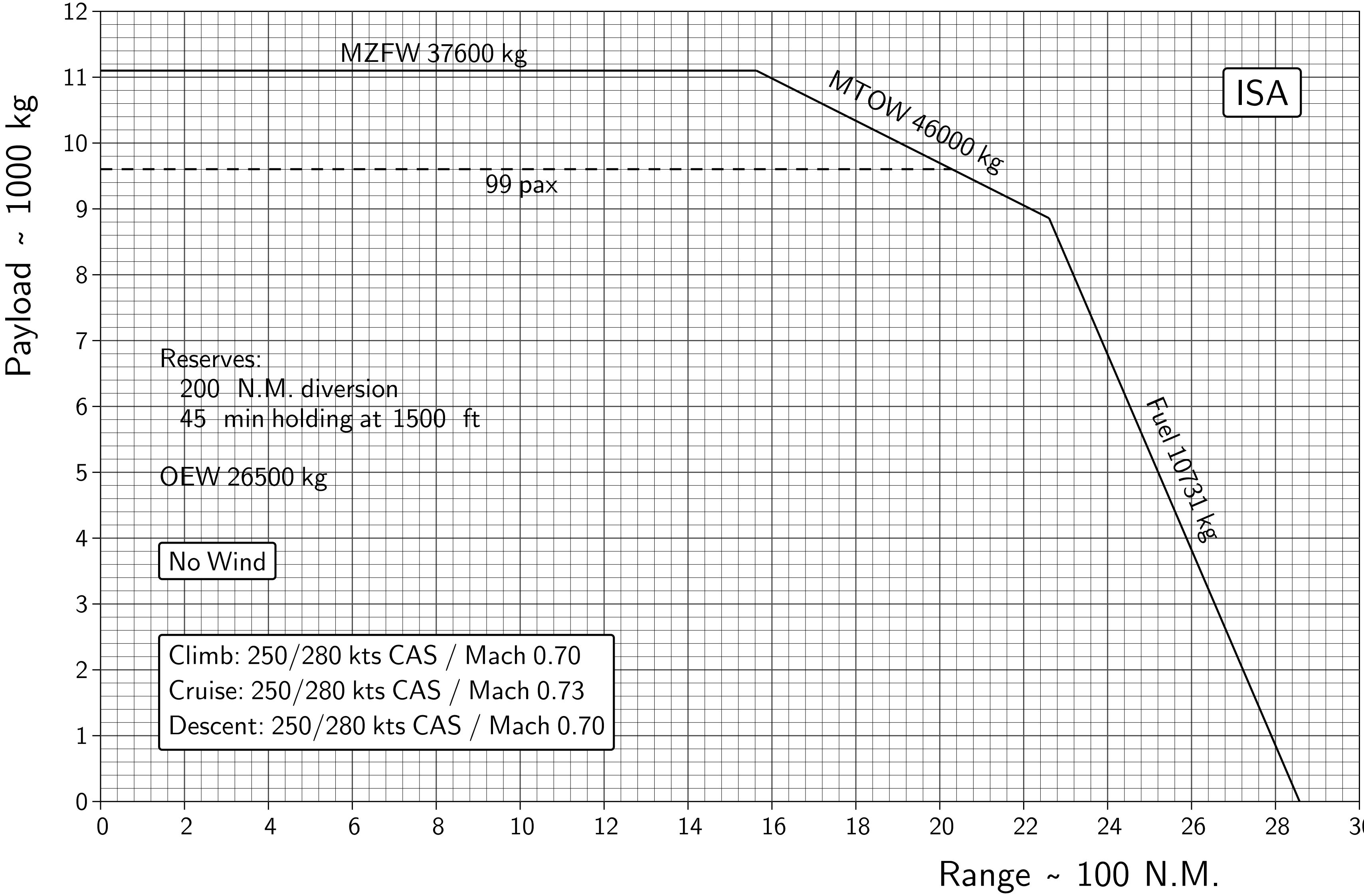

Figure 11.3: Payload-range for climb at 250/280 kts CAS / Mach 0.70, cruise at 250/280 kts CAS / Mach 0.73, descent at 250/280 kts CAS / Mach 0.70 at ISA.

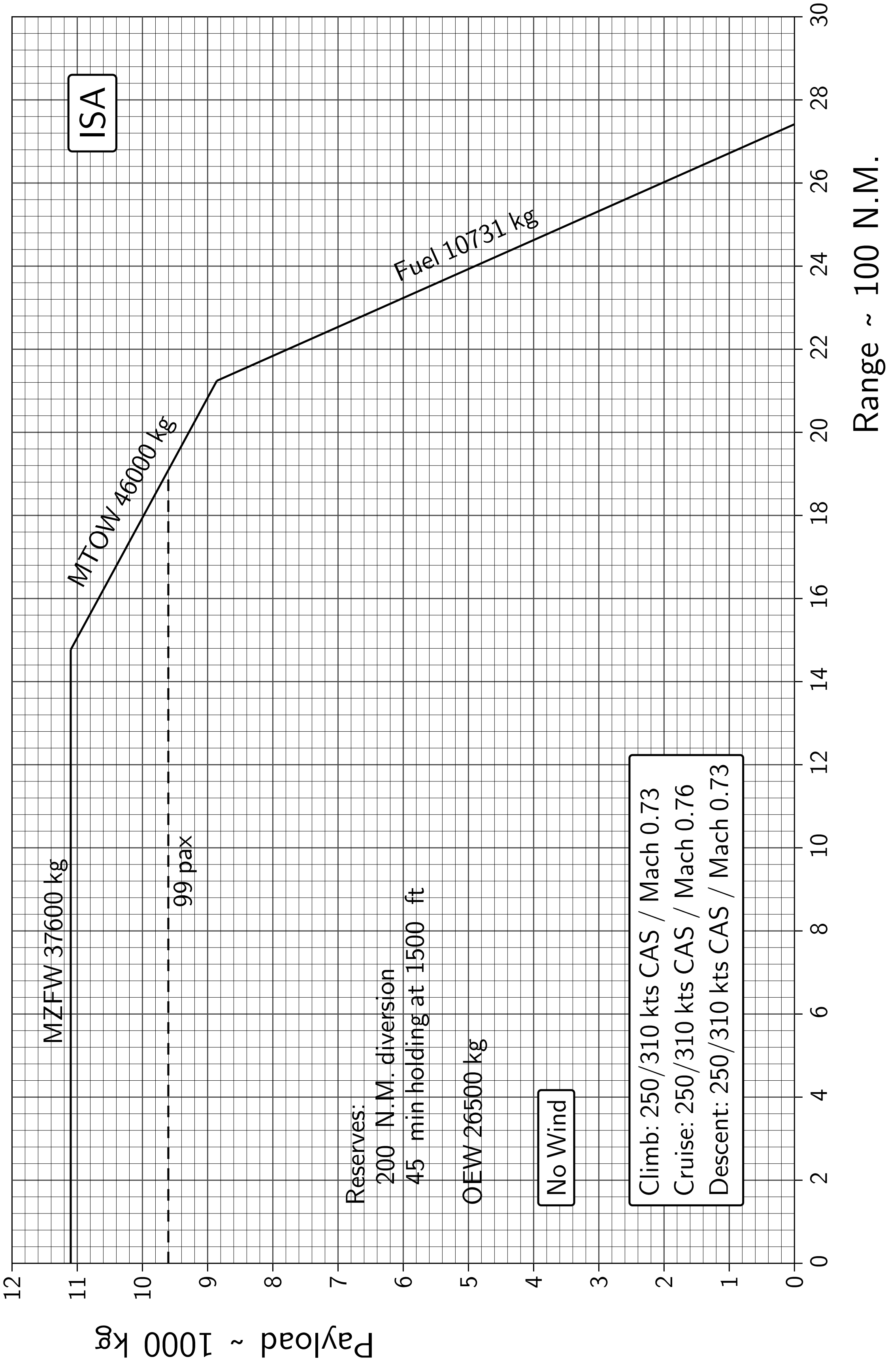

Figure 11.4: Payload-range for climb at 250/310 kts CAS / Mach 0.73, cruise at 250/310 kts CAS / Mach 0.76, descent at 250/310 kts CAS / Mach 0.73 at ISA.

Chapter 12

Ceiling with one engine inoperative

Assumptions

One engine inoperative.
The ceiling is defined by a gross gradient of 1.1 %.
Anti-icing off, airconditioning off below 13 500 ft.

Figures

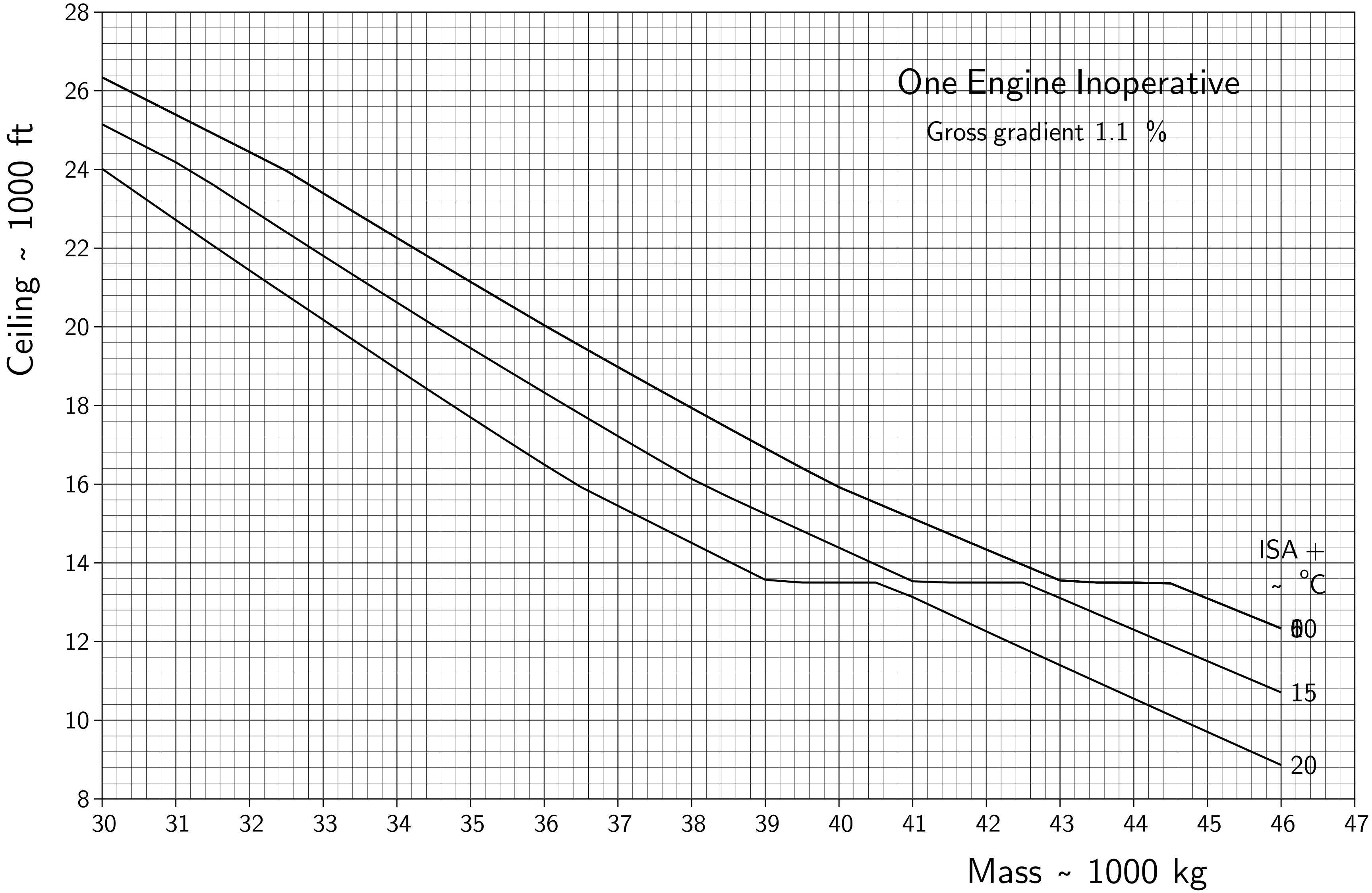

Figure 12.1: Ceiling with one engine inoperative.

Chapter 13

Driftdown with one engine inoperative

Assumptions

One engine inoperative.
The net flight path is the gross flight path diminished by 1.1 %.
Anti-icing off, airconditioning off below 13 500 ft.
No wind.

Figures

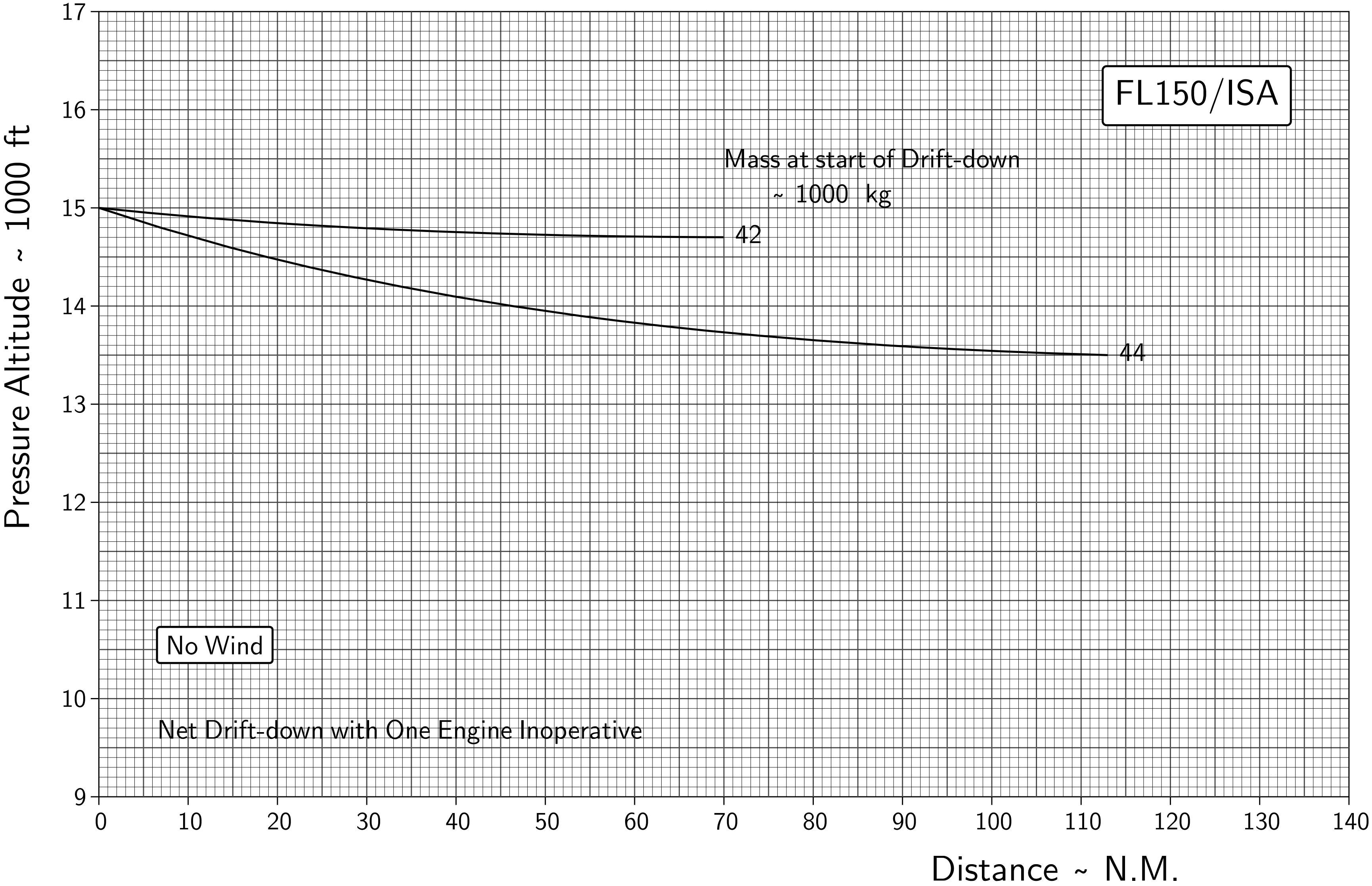

Figure 13.1: Driftdown from FL150 at ISA.

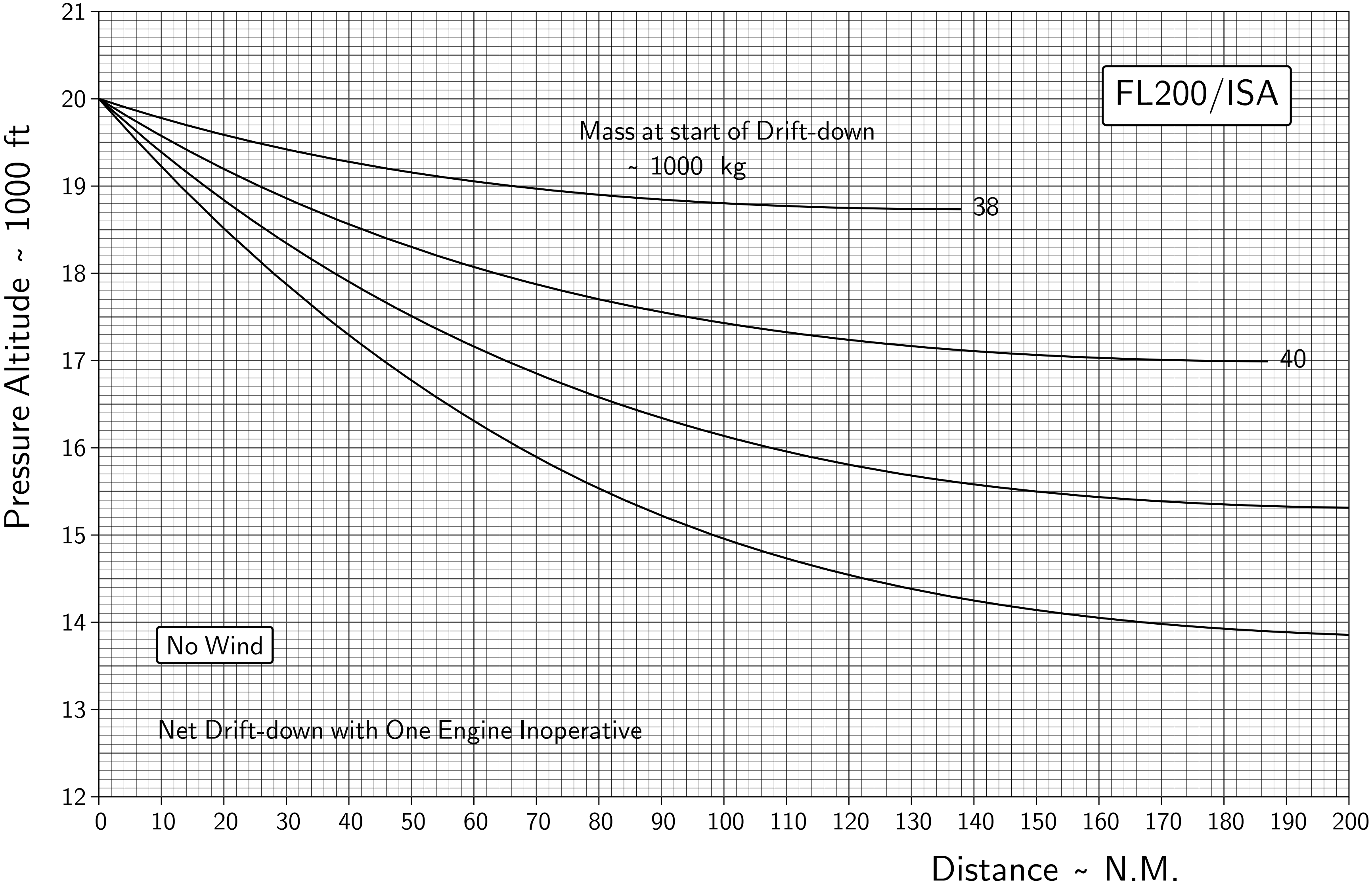

Figure 13.2: Driftdown from FL200 at ISA.

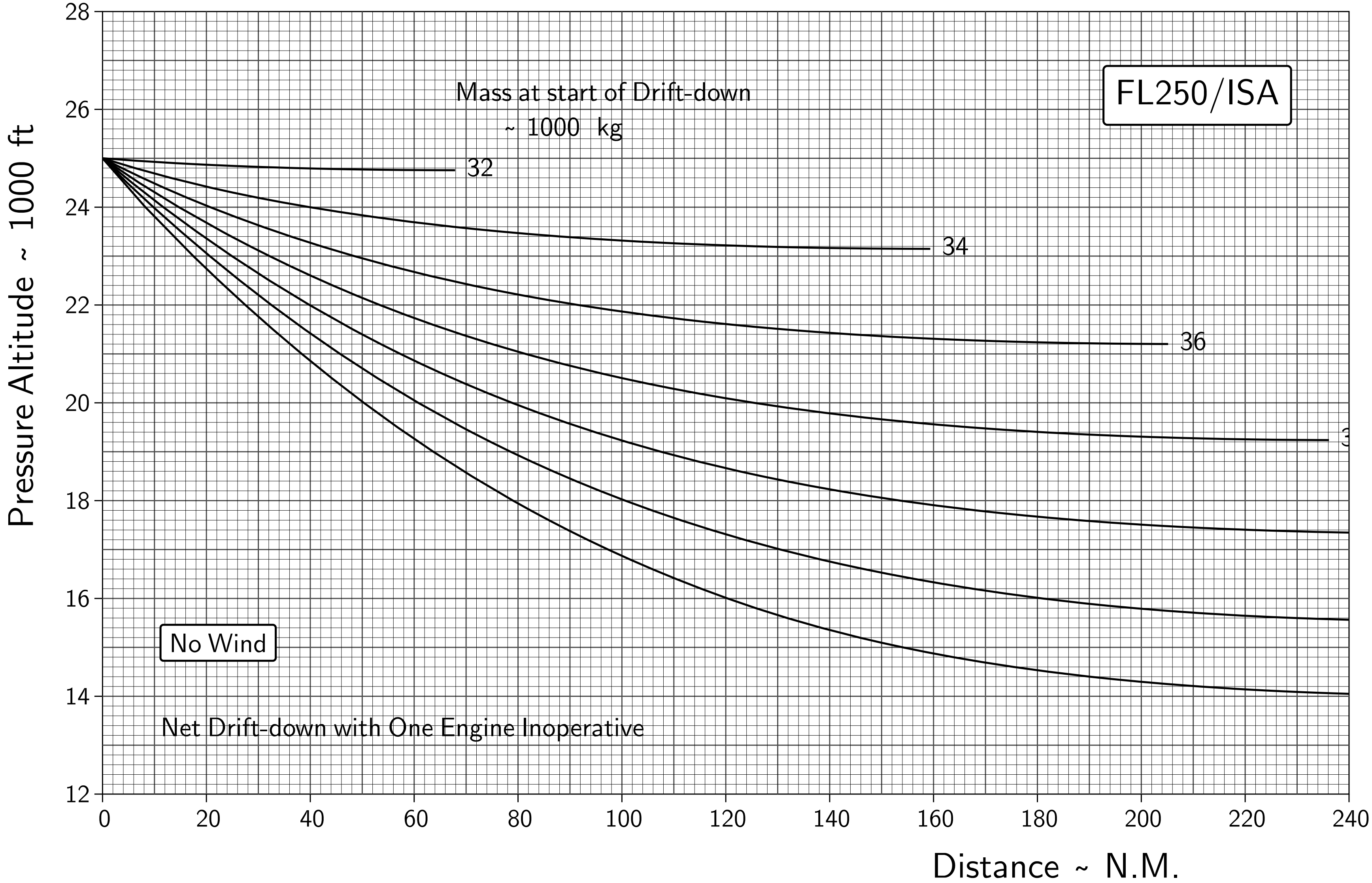

Figure 13.3: Driftdown from FL250 at ISA.

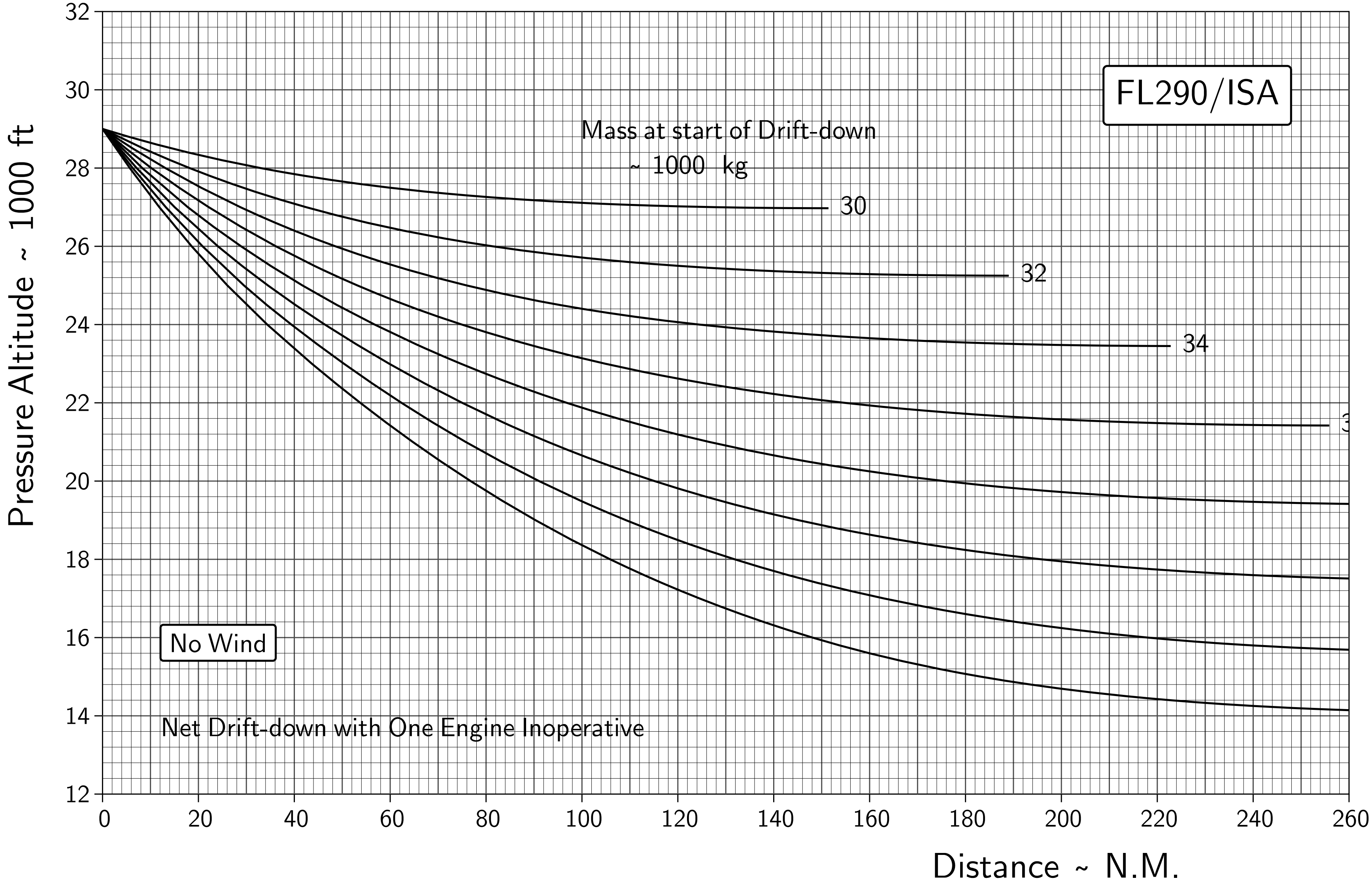

Figure 13.4: Driftdown from FL290 at ISA.

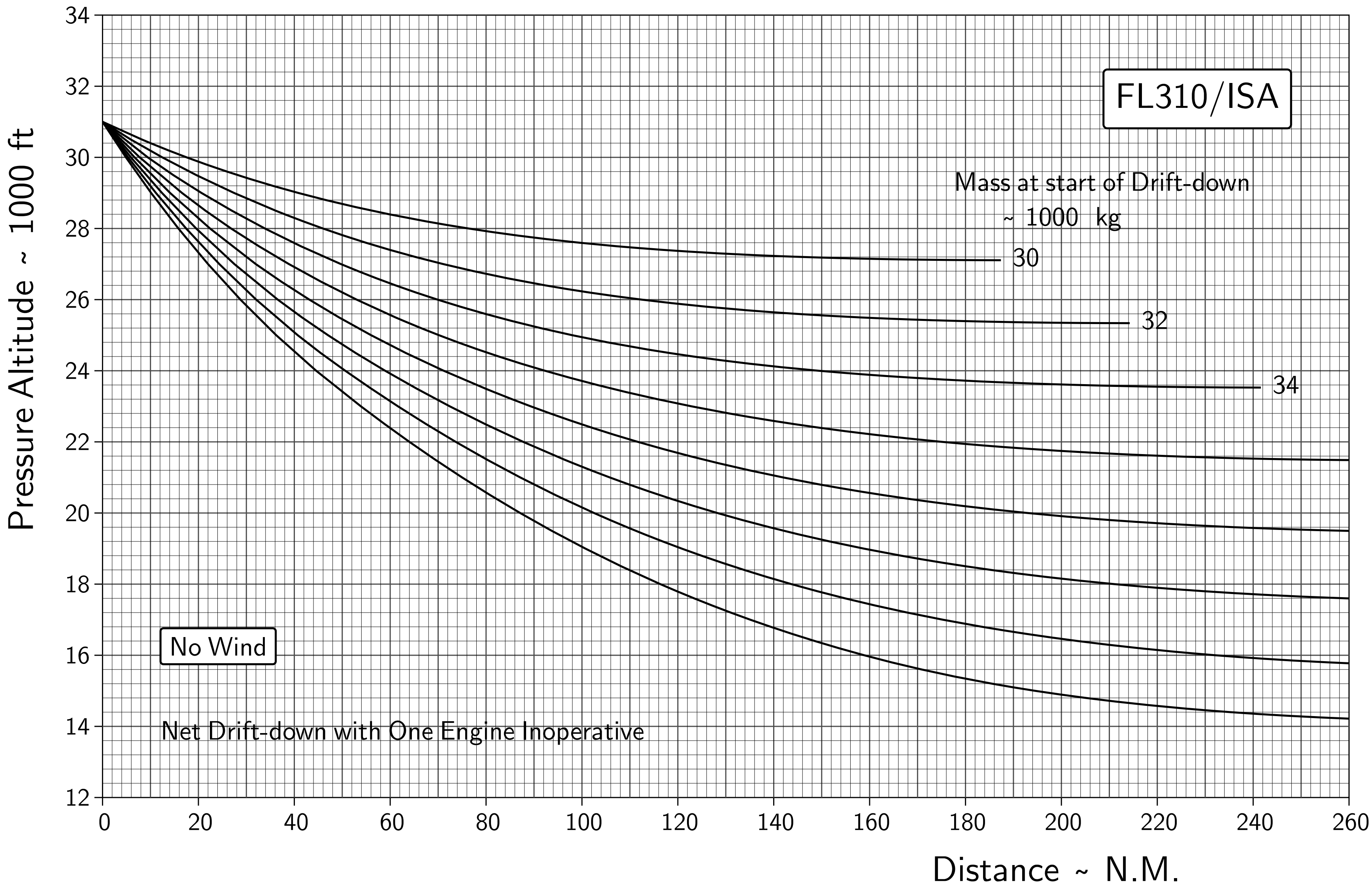

Figure 13.5: Driftdown from FL310 at ISA.

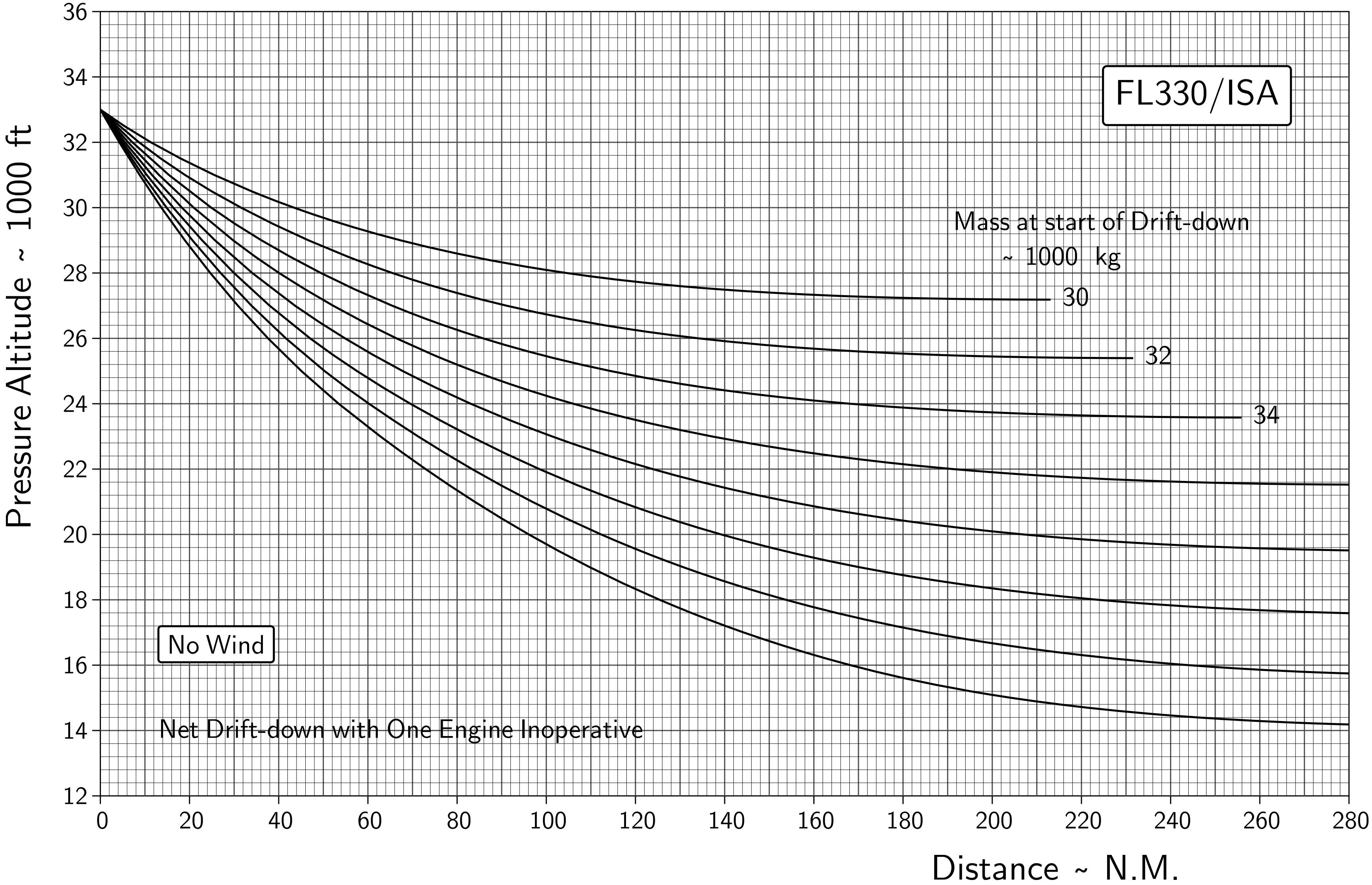

Figure 13.6: Driftdown from FL330 at ISA.

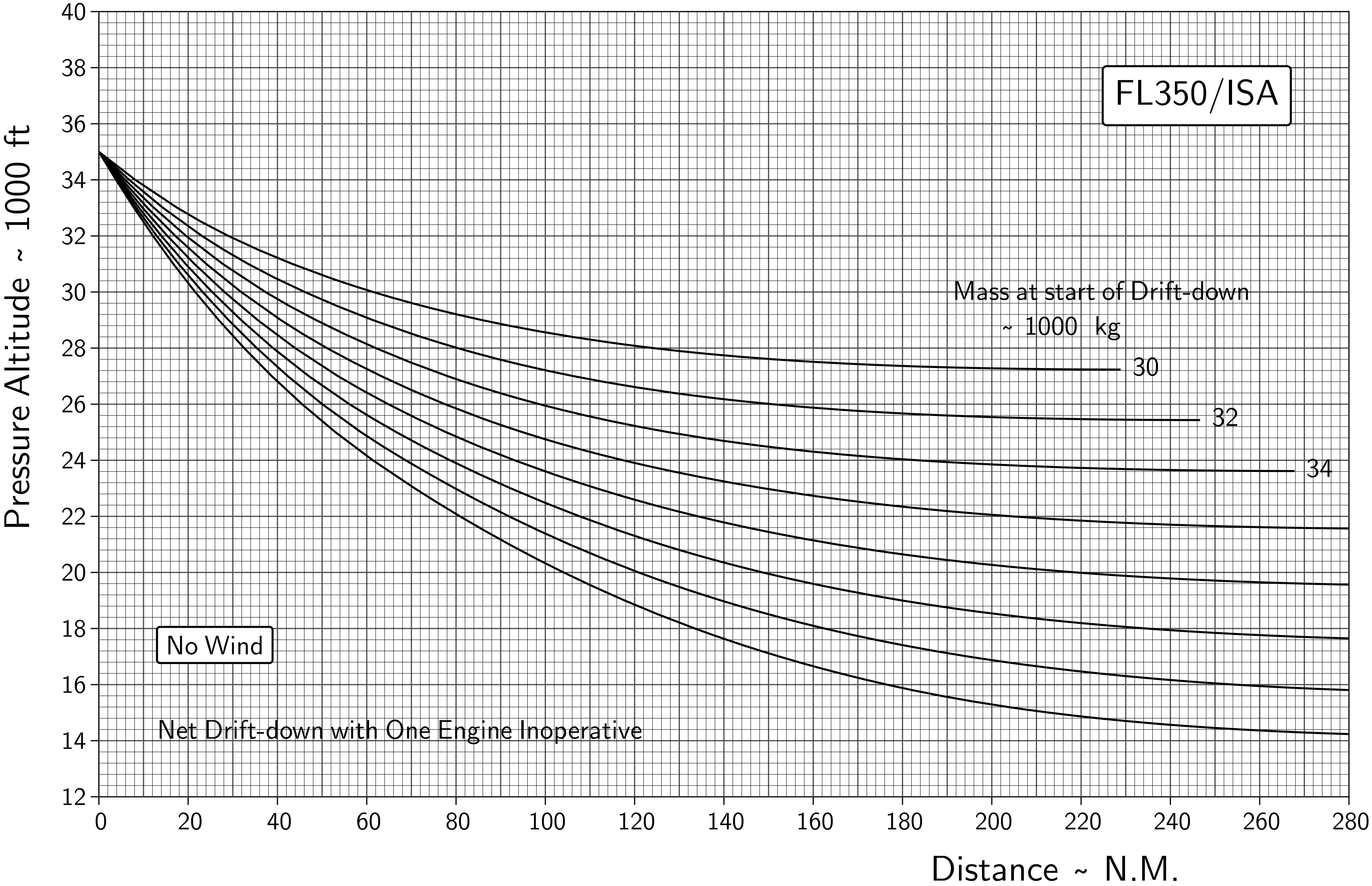

Figure 13.7: Driftdown from FL350 at ISA.

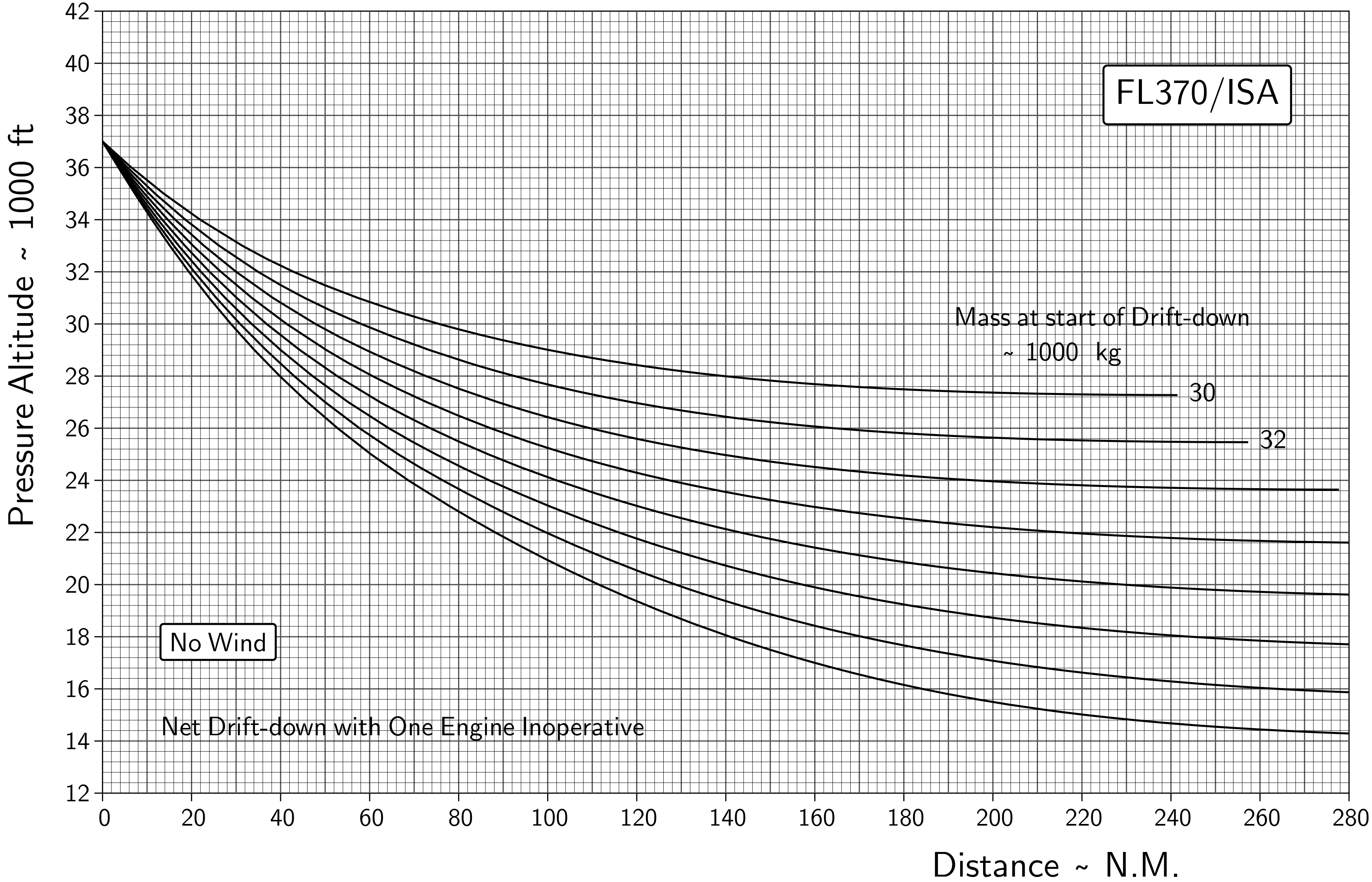

Figure 13.8: Driftdown from FL370 at ISA.

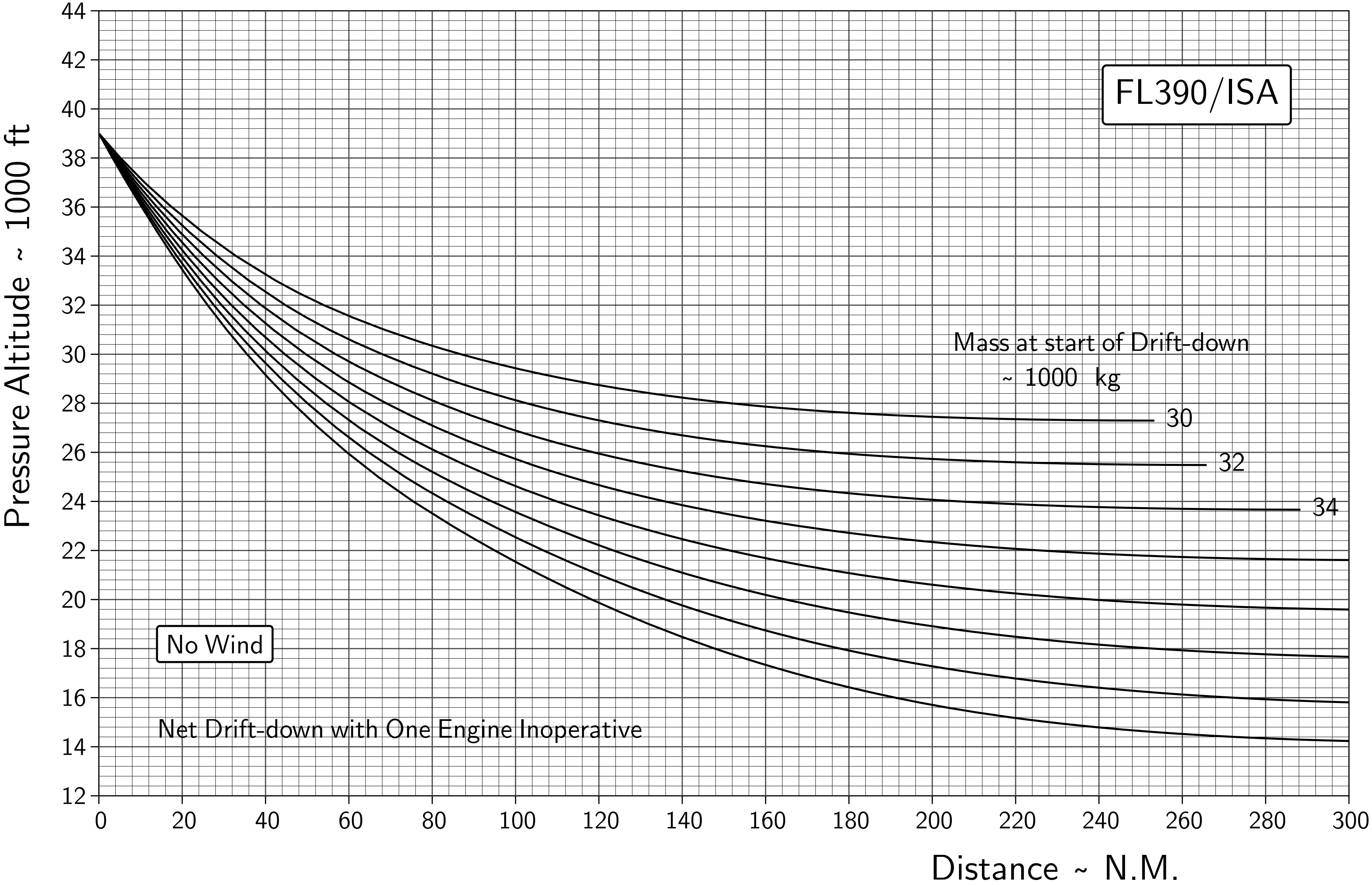

Figure 13.9: Driftdown from FL390 at ISA.

Chapter 14

Airspeed conversion

Assumptions

International Standard Atmosphere defined by International Organization for Standardization, ISO 2533, 1975

Figures

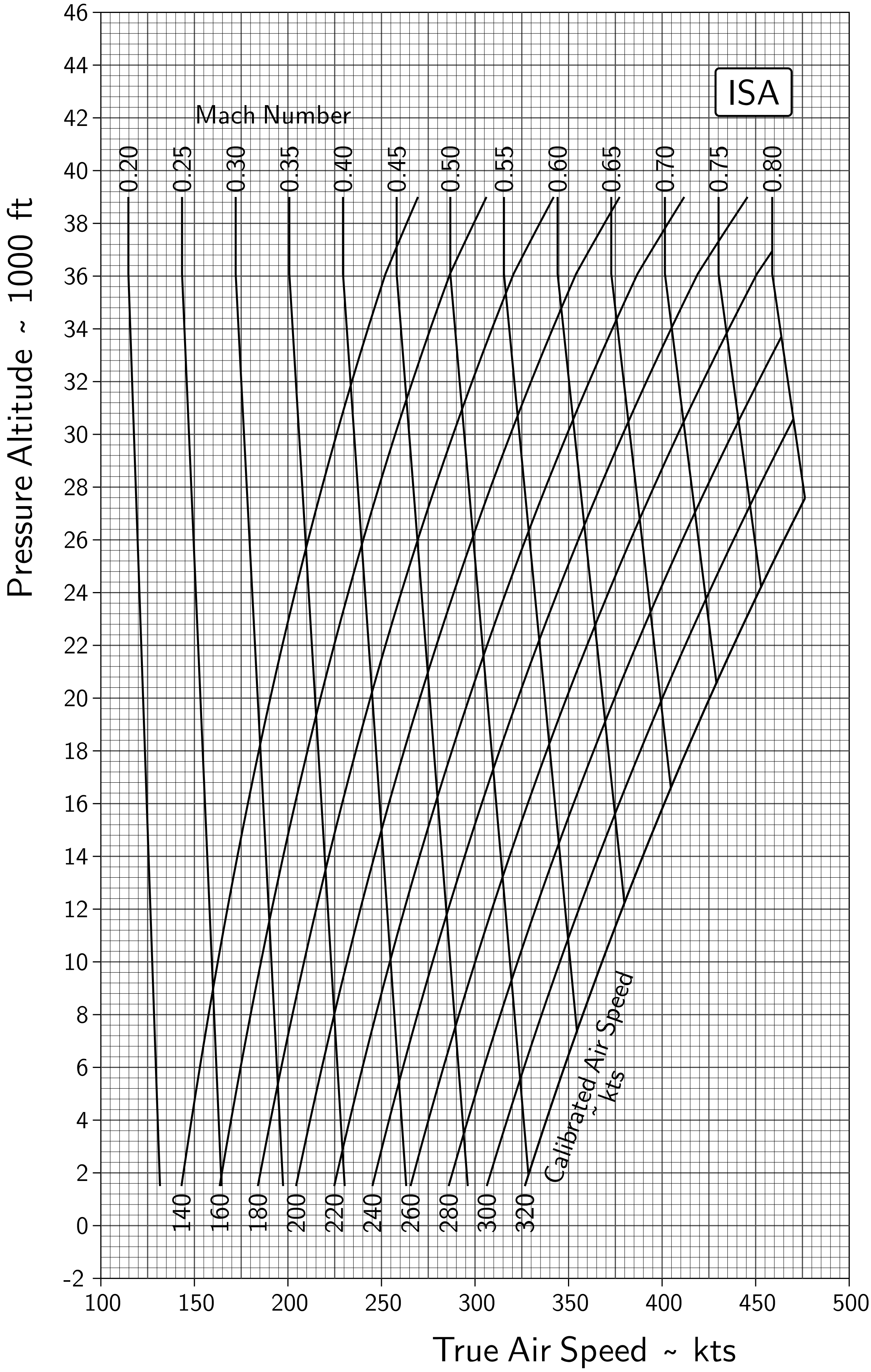

Figure 14.1: Airspeed conversion chart at ISA.